University of Hawaii at Manoa

Office of the Chancellor
Hawaii Hall 105 • 2500 Campus Road

MEMORANDUM

June 25, 1979

TO: Librarian Don Bosseau
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Director Donald Topping

FROM: Howard P. McKaughan
Acting Chancellor

SUBJECT: Report of Academic Computing Advisory Committee

The subject committee sent this office several copies of its report for distribution. I believe you will find the conclusions of the committee valuable guides. I commend it to your use.

Attachment

cc: Acting Vice Chancellor Robert Sakai

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UNIVERSITY OF HAWAII

Office of the Vice-President for Academic Affairs

June 15, 1979

'79 JUN 15 P4:18

MEMORANDUM

TO: Dr. Howard P. McKaughan
Acting Chancellor

SUBJECT: ACAC Report

Thank you for your memo and comments regarding the report of ACAC. The purpose of our comparative analysis was to demonstrate the inadequacy of academic computing funds within the University of Hawaii. We purposely took two institutions that were relatively similar to Manoa; although we could have selected other universities that would have indicated an even greater discrepancy in funding of computing; e.g., the Big Ten or the University of California. In any event, I appreciate your kind letter and your support of our efforts.

The Committee's recommendations for academic computing are now complete and have been referred to the Vice President and President for review and decision-making regarding the recommendations.

Because there are various budget and organization considerations involved in the ACAC recommendations, it will likely be later this summer before we know the outcome of the Administration's review. In the meantime, I thought you would perhaps enjoy receiving a copy of the Committee's final report. Twenty additional copies are enclosed for you to share with the Faculty Senate Chairperson, the Library, the Vice Chancellor, the Manoa Deans and Directors of major reserach institutes.

Warren
Warren W. Gulko
ACAC Chairperson

cc: ACAC

A PLAN FOR MEETING THE ACADEMIC COMPUTING NEEDS OF THE UNIVERSITY: 1979 - 1985

University of Hawaii
Academic Computing Advisory Committee

Report of the

University of Hawaii

Academic Computing Advisory Committee

Proposing A

PLAN FOR MEETING THE ACADEMIC COMPUTING NEEDS OF THE UNIVERSITY: 1979-1985

Submitted to Vice President Durward Long

May 25, 1979

ACAC Committee

Richard Aadland, Leeward CC
Carl Farrell, UH-Manoa
Warren Gulko, Chairperson, UH-Administration
William Higa, UH-Hilo
Charles Lamoureux, UH-Manoa
Wayne Lichtenberger, UH-Manoa
Robert Peppin, Kapiolani CC
Vincent Peterson, UH-Manoa
Barbara Polk, CC-Administration
Kenji Sumida, UH-Administration

CBE-Subcommittee

David Cleveland, Honolulu CC
Carl Farrell, UH-Manoa
William Higa, UH-Hilo
John Hylin, UH-Manoa
Charles Lamoureux, UH-Manoa
Robert Peppin, Chairperson, Kapiolani CC

UH-Computing Center Staff Participants

Dan Arashiro
Walter Yee

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UNIVERSITY OF HAWAII

May 25, 1979

MEMORANDUM

TO: Vice President Durward Long

SUBJECT: Recommendations of the Academic Computing Advisory Committee

The Academic Computing Advisory Committee (ACAC) has concluded the first half of its charge by assessing the state of academic computing in the University and recommending a plan to meet future needs. Our findings and recommendations are contained in the enclosed report. The ACAC report, which represents a year of work by the Committee, has benefitted from considerable input by staff and faculty of the University including an open hearing on the Manoa Campus on May 9, 1979 and additional solicited comments from the entire University academic community. The paragraphs below summarize the major findings of the Committee. Details concerning these recommendations are contained in the report following. Members of the Committee are available over the summer to answer any questions or clarify any matter pertaining to the report.

1. <u>Inadequate Funding of Academic Computing</u>

   The Committee has concluded that the University of Hawaii lags similar universities throughout the nation in providing an appropriate level of academic computing support. We find that a serious shortage of computing capability exists which is now impacting the quality of our teaching and research activities. We believe the shortage gap of academic computer services can be corrected by restructuring the present system and providing a systematic infusion of funds over the next six years.

2. <u>Improve Computer Services to All Campuses</u>

   We recommend that a basic level of computing support be provided to the University's academic programs from centrally allocated resources. The intent of this report is that academic computing services should be made available to the entire University of Hawaii academic community. The Committee's objective is to provide an easily accessible academic support facility comparable in many ways to the library -- indeed, as important to some disciplines as the library is to others. In order to meet this objective we recommend the development of distributed computing facilities throughout the campuses of the University.

3. Reorganize Computing

We recommend that the present UH Computing Center be divided into two units, one dedicated to serving the internal administrative information processing needs of the University, and a second dedicated to serving the academic computing needs of the University. It is intended that the proposed Center for Academic Computing Services (CACS) would provide central staff and basic resource support to academic computing facilities located on the various campuses of the University. Campuses may expand the basic central support in accordance with their internal priorities.

We suggest that the proposed center for information processing services and the center for academic computing services initially report to separate organizations. At some future point, however, it may be appropriate to establish a new central University department of computing services which would be responsible for executive management of the two centers and overall policy direction for computing services.

4. Orderly Transition in Three Phases

The proposed plan for meeting the present and future University needs for academic computing services calls for an orderly transition from the existing shared IBM 370 computer to new independent academic computing facilities. The plan is intended to allow time for adequate user conversion and training periods and to assure development of a substantial library of the most commonly required programming languages and computer software packages. The plan has been organized into three phases and is described in terms of types of computing facilities equivalent to the level of computing services required to meet minimum needs. The actual hardware may vary as a result of programming.

a. The first phase requires immediate action toward establishing an academic computing system through procurement of a 100-port timesharing facility to be located at UH-Manoa and accessible to all campuses. Also called for in this paase is the assignment of the currently-existing HP-2000 to the proposed Center for Academic Computing Services (CACS) and the acquisition of two 16-port timesharing facilities for servicing the community colleges.

b. The second phase, expected to be implemented in fiscal 1981-83, calls for the procurement of a large-scale batch computer to satisfy research and scientific computing needs as well as the acquisition of additional small-scale timesharing computers for UH-Hilo and two community college sites. It is also planned that the second HP-2000 (now being acquired) will be assigned to CACS during this phase. At the end of this phase, most academic users will have shifted to the academic computer system.

c. The third phase calls for two additional small-scale timesharing computers for servicing the community colleges, the upgrading of one small-scale community college facility, and the acquisition of a second 100-port timesharing facility located at UH/Manoa.

5. <u>Begin Physical Planning Now</u>

In addition to hardware acquisitions, there will be a need for physical facilities and support personnel at each academic computing site. We recommend that planning begin immediately to locate a full-service computer facility on the Manoa Campus independent of the central administrative computer center.

6. <u>Charge Special Purpose Users</u>

At all sites, it is our recommendation that service fees be charged to sponsored research users and other special purpose users. Any funds collected should be used to acquire additional personnel or equipment to supplement the basic level service and to reimburse the loss of computing services as a result of the special purpose users.

7. <u>Establish a System of Governance</u>

We recommend the creation of individual governing committees for each campus or computing site to provide user input and policy direction for site specific matters. In addition to these committees, we recommend the continuation of the systemwide Academic Computing Advisory Committee with new membership to be selected from the members of the individual campus level committees, plus ex-officio representation for the director of CACS and central academic administration. ACAC would continue to have policy responsibility for coordinating all University academic computing.

8. Establish a Parallel Process for Administrative Computing

We suggest that the University Administration consider some parallel form of participatory user input and policy direction for the proposed center for information processing services.

9. Commit to Text Processing

Text processing, using the computer's storage and retrieval capability to edit and process text, is a rapidly growing area. Text processing can significantly reduce faculty and staff time in text generation and clerical time in production. We suggest, therefore, that an institutional commitment to text processing be made and that efforts be undertaken to incorporate a planned and controlled introduction of text processing technology.

10. Timesharing Improvements are First Priority

The Committee recommends that first priority be given to upgrading the basic academic computing services and developing an adequate timesharing system for the students and faculty of the University. After meeting the immediate timesharing needs of the academic community, the University of Hawaii should consider supporting a prototype implementation for computer-assisted instruction at one or more campuses of the University.

11. Expand PLATO

The Committee addressed computer-assisted instruction (CAI) as a matter separate from other forms of academic computing. CAI belongs in the realm of educational technology rather than computer technology, and should be considered with general academic computing services only insofar as sharing of computer hardware or operations might be appropriate. We recommend that the future direction of CAI in the University be an expansion of the current PLATO facilities through prototype installations for productive use at one or two selected sites over a multi-year time frame. We further recommend that computer-assisted instruction be funded and directed independently from other academic computing services.

In the event that sufficient funds are not available for the prototype installation, the Committee urges, at the minimum, the establishment of a small CAI office. The CAI office should be funded centrally to maintain an ongoing effort in CAI, to keep University personnel current in CAI technology, and to provide a central resource and coordination effort. The CAI office should be regarded as an instructional activity and assigned accordingly.

In preparing its recommendations, the Committee has attempted to reflect the realities of current and future funding of higher education in Hawaii. In the course of your deliberations and subsequent decision making regarding these recommendations, please recognize that we used minimum needs as the basis of our planning. We cannot, therefore, assure you that a decision to implement this plan will satisfy all future needs of academic computer users, since to provide such an assurance would require resources well beyond reasonable expectations. We can, however, assure you that considerable dissatisfaction will likely occur if the minimum forecasted needs are not met in the near future.

The provision of adequate computing services to academic staff, faculty, and students is an increasingly serious problem at the University of Hawaii. We urge your immediate attention to these recommendations and to the decisions which are necessary to begin the process of improvement. It should be noted that even with an immediate, all out effort to correct the situation, many students and faculty will be denied proper computer services in the Fall 1979 Semester. On the other hand, with your support and approval, we believe that this plan will provide improved computing services beginning Spring 1980 and that we can upgrade academic computing to a position worthy of our University by 1983.

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UH-Manoa

Kenji Sumida
Kenji Sumida, ACAC
UH-Administration

Section 1

INTRODUCTION TO THE REPORT

The Academic Computing Advisory Committee (ACAC) was established by Vice President Long in April 1978 to advise the University Administration "... on policy matters concerning the delivery of computer services to meet the academic needs of our University." In his letter of April 5, 1978, Vice President Long charged the Committee with the following tasks:

1. Assess the current state of computer services provided to support the academic programs of instruction, organized research, and public service;
2. Identify the near and long-range future requirements for computer support to academic programs;
3. Recommend a plan for meeting these needs;
4. Monitor the implementation of the plan; and,
5. Advise the Vice President for Academic Affairs on policy matters concerning the delivery of computing services to the academic programs.

This report speaks to the first three items of the Committee's charge. It is submitted to the Administration after a year's work and study by ACAC and following University-wide consultation on the recommendations to alleviate the identified problems concerning academic computing services.

In reviewing the Committee's findings and recommendations the reader is reminded that for many academic disciplines the computer is as important and integral to learning and research as the library or laboratory is to other disciplines. In any modern university, the computer is a primary research tool and represents one of the few alternatives available for substantially improving the delivery of instructional services. In order for the University of Hawaii to attract new outstanding scholars, indeed to attract and retain certain types of external funding, the University of Hawaii must provide its faculty and students with timely, effective, and efficient computing support. The intent of this ACAC report is to ensure that support.

1.1 CURRENT STATUS OF ACADEMIC COMPUTING

The establishment of a University Academic Computing Advisory Committee (ACAC) grew out of a growing concern over the declining state of computing services provided to the academic community. The first task undertaken by the ACAC was an investigation of the current status of academic computing services including the relative allocation of resources, how we compare to other universities, and what steps could be taken to correct the problem.

Historically, at this and other universities, the problem of inadequate computing has often been addressed by acquiring a new larger computer. Although sufficient computing capability is fundamental to the problem, often the need for computing services is more complex than simply more machine time, greater memory, or faster computations. Therefore, our findings consider not only equipment matters, but also address other aspects of computing services including structure and organization issues. This section of the report addresses the problem of computing services for academic programs and describes the Committee's recommendations to substantially improve the quality and quantity of academic computing services provided by the University of Hawaii.

1.1.1 A Technology Gap at the University

After considerable review of the state of computing services for academic programs, the Academic Computing Advisory Committee (ACAC) concludes that at the present time the University of Hawaii has fallen significantly behind American higher education in both educational and research applications of computer technology. The primary cause of this "technology gap" is inadequate computer capability for appropriate support of the University's academic programs and activities. The integration of computer technology with student learning, a requirement for contemporary collegiate level training in many fields, is inhibited by the lack of machine access and overcrowded, limited timesharing services. Inadequate computer capability is restricting the development of computer technology as an instructional aid for our students. Using the computer as a research tool is similarly constrained, in part by limited access to the hardware, and in part by the shortage of trained computer programmers and system designers to serve as consultants to faculty on complex computing problems.

1.1.2 The Distribution of Resources

At the present time, the basic academic computing needs of the University of Hawaii faculty and students are being met primarily by sharing an IBM 370/158 computer with administrative users throughout the entire statewide University system. Supplementing the IBM 370/158 is a small HP 2000 timesharing system. Last year, the University of Hawaii spent $1.90 million of centrally budgeted State general funds on both statewide academic and central administrative computing services including the Management Systems Office.

Of these amounts, we estimate that $1.22 million was spent in direct support of ongoing internal administrative needs of the University and $679,000 was available for servicing the academic needs of faculty and students. These data thus show that the University in 1977-78 allocated to academic computing approximately half of the amount provided in support of administrative computing. Moreover, the amount of funds presently directed toward academic computing represents less than one per cent (0.65%) of the total University budget of $103.7 million. Therefore, it would appear that within the University's overall priorities, academic computing is allocated an inadequately small amount of the available resources, relative both to overall computing services and to all University programs.

1.1.3 Computing Expenditures at Two Comparable Universities

The inadequate investment of University resources in academic computing is illustrated clearly by comparing the University of Hawaii with other institutions of higher education. For example, the University of Massachusetts at Amherst spent $3.1 million in 1977-78 for academic and administrative computing, representing 4.3% of the campus state-funded operating budget. In the same year, the University of Colorado at Boulder spent $2.2 million on academic computing alone exclusive of the cost for the main computer which they own. If rented, academic computing at Colorado would cost an additional $0.8 million per year. Both of these universities are representative of typical university computing expenditures in American higher education and point out the extent to which the University of Hawaii has fallen behind in the application of computer technology to meeting academic program needs.

As the following table indicates, both the academic and administrative functions of the University of Hawaii are lagging behind the rest of the country because of insufficient investment in computer services. For comparative purposes we have reflected UH System centrally budgeted expenditures for computing as if they were UH-Manoa expenditures and compared them to the main University campus in two similar multicampus State systems. For comparability, extramural funding is excluded.

Table 1.1

Comparison of 1977-78 State-Funded Expenditures

	University of Colorado-Boulder	University of Mass-Amherst	University of Hawaii-Manoa
1. Funding ($ in Millions)			
a. Operating	$ 65.7	$ 72.3	$ 70.2
b. Federal Grants & Contracts	$ 22.6	$ 13.1	$ 32.4
2. Enrollment			
a. Total Enrollment	20,500	22,055	20,950
b. Percent Graduate	18%	13%	20.4%
3. Computing Expenditures ($ in Millions)			
a. Academic	$ 2.24 (+.80)*	$ 1.64	$ 0.68
b. Administrative	$ 1.12 (+.50)	$ 1.48 (+.50)	$ 1.22
c. Total	$ 3.36 ($4.7)	$ 3.12 ($3.6)	$ 1.90
4. Percent of Operating Budget			
a. Academic	3.4%	2.3%	1.0%
b. Administrative	1.7%	2.0%	1.7%
c. Total	5.1% (7.2%)	4.3% (5.0%)	2.7%
5. Computing $/Student			
a. Academic	$109.27	$ 74.36	$ 32.46
b. Administrative	$ 54.63	$ 67.10	$ 58.23
c. Total	$163.90 ($228)	$141.46 ($164)	$ 90.69

* *Numbers in parenthesis reflect add-on expenses for comparability -- see text.*

It is important to note in reviewing the above data that both the University of Colorado and the University of Massachusetts academic computer centers do not provide computer support to their respective medical centers, since in both cases the medical schools are separate campuses with their own computer facilities. The administrative centers of both institutions support primarily the main campus but also provide support services to other campuses of each university. Similarly, the academic centers of both institutions provide a small amount of support to other campuses but to a lesser degree than the administrative centers. Colorado and Massachusetts administrative computing data should be adjusted to reflect the annual payment equivalent to the Hawaii machine ($0.5 million) and Colorado academic computing data should be adjusted ($0.8 million) to reflect the rental equivalent of their owned large-scale academic computing hardware.

The comparison of these two institutions with the University of Hawaii Manoa Campus is at best conservative:

- In Hawaii the computer budget supports our entire state higher education system;
- The Manoa Campus receives considerably more federal grants and contracts than either Boulder or Amherst;
- The Manoa Campus has a higher proportion of graduate students; and,
- UH Manoa includes a medical school.

The above factors all contribute to a greater demand for academic computing services in the University of Hawaii and require the allocation of considerable resources toward relieving that demand. In other words, given the nature of the comparative institutions, one would expect the University of Hawaii to have invested the equivalent of a larger proportion of its budget and/or more dollars per student in both academic and administrative computing than either of these comparable universities. The data indicate, however, just the opposite since the University of Hawaii is investing considerably less than either of the institutions with the resulting lack of computer capability to adequately support our academic programs. The lack of adequate computing support to the academic programs seriously undermines the quality of our educational and research efforts and denies our students the opportunity to fully explore and benefit from the applications of computer technology.

Note that data drawn from other comparable mainland universities would result in at best an equivalent analysis, and the University of Hawaii would lag in terms of expenditure by a factor of two or three. Moreover, if we were to compare with major public research universities in states such as Illinois, California, Minnesota, or Pennsylvania, we would find the computer technology gap to be considerably greater than indicated by the data above. We conclude, therefore, that the University of Hawaii lags the nation in maintaining an appropriate level of academic computing support. We find that a serious technological gap exists which is now impacting the quality of our teaching and research activities. Some examples which illustrate this impact and the severity of the situation are compiled in Appendix B of this report.

In the material following, we address only the academic computing needs of the University of Hawaii. Administrative requirements are, we believe, a separate issue and should be addressed independent of academic requirements except to the extent that sharing of personnel and hardware is appropriate. Additionally, the appropriate allocation of computing dollars to administrative and academic needs is a matter of continuing concern, and for this reason we have recommended a governance structure (described in section 1.2.3) to alleviate conflicts and maintain appropriate faculty and other user input to the decision process.

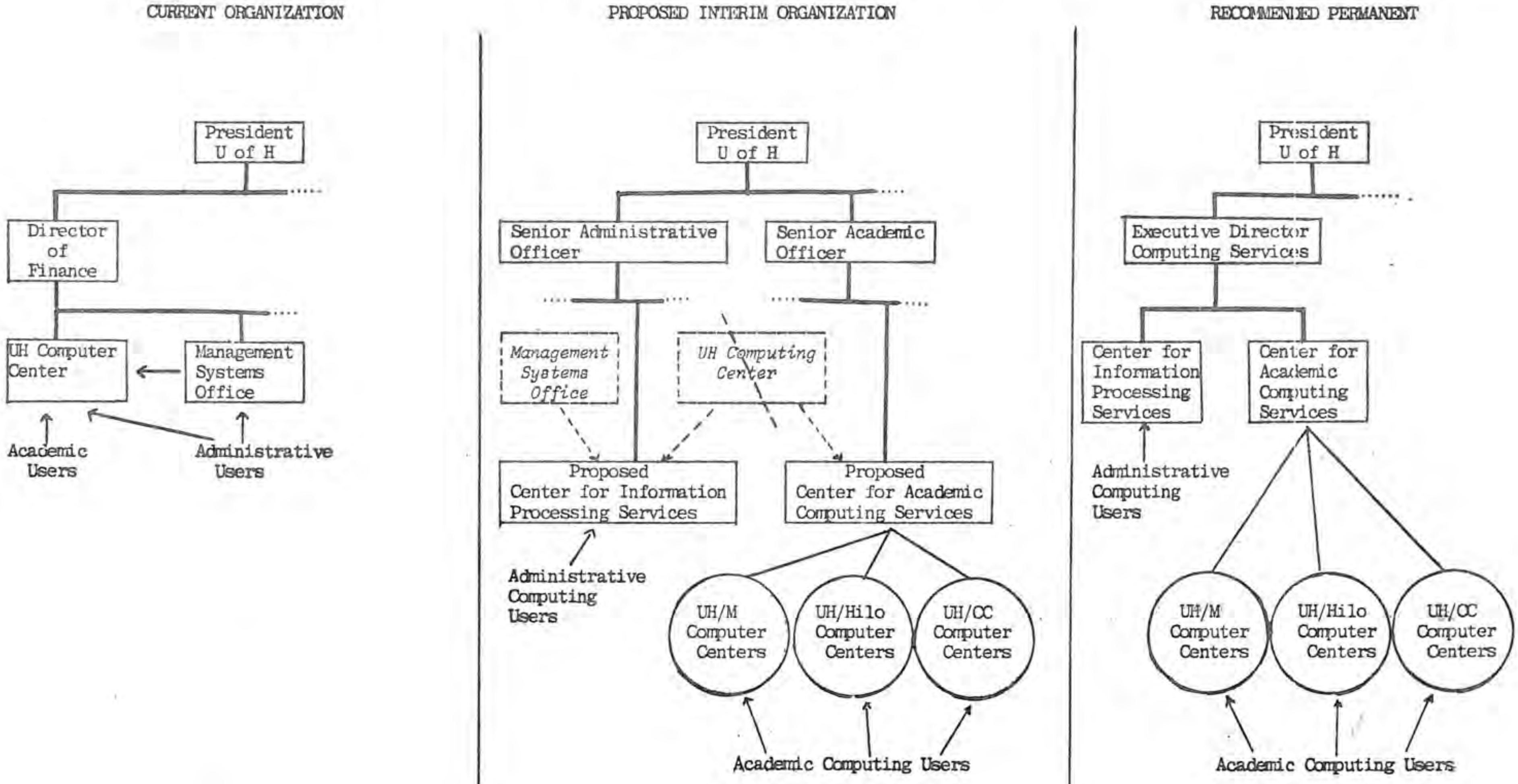
1.2 PROPOSED CENTER FOR ACADEMIC COMPUTING SERVICES

The gap in academic computer services can be corrected by restructuring the present system and providing a careful, systematic infusion of funds over the next six years. We recommend the establishment of a coordinated, systemwide academic computing service under the direction of a proposed new center for academic computing services. In order to focus development of an academic computing system, the present UH Computing Center should be split into two units, one center dedicated to serving the internal administrative information processing needs of the University, and a second dedicated to serving the academic computing needs of the University.

Figure 1.1 shows a proposed organization phasing to establish a new structure for providing computing services. We suggest that both the proposed center for information processing services and the proposed center for academic computing services initially report to separate organizations; but, at some future point it may be appropriate to establish a new central University department of computing services which would be responsible for executive management of the two centers and policy direction for computing services. This new department would provide executive leadership and policy support to the administrative and academic computing programs of the University, and serve as the administrative/political interface for both operations.

The proposed structure permits each center director, academic and administrative, to devote full attention to servicing their respective user communities. The interim organization provides an orderly transition period until the acquisition of a central large scale computer in 1981 at which time it may be appropriate to establish a permanent executive office with line responsibility for both academic and administrative computing. The executive organization provides policy direction along with both the economies and efficiencies of central coordination and staffing. At the same time this approach dedicates computing staff and management services to the unique and special needs of the respective academic and administrative user community.

Figure 1.1 PHASED ORGANIZATION FOR COMPUTING



1.2.1 Mission of the Center for Academic Computing Services

The mission of the University of Hawaii Center for Academic Computing Services (CACS) is to provide the students and faculty of the University of Hawaii with timely and appropriate access to computer technology. To accomplish this mission, the Center for Academic Computing Services should seek every method possible to facilitate access by students and faculty to contemporary computer technology. Access will be provided through the most appropriate means -- often an existing campus computer, but may also be provided through additional leased or dedicated hardware, remote terminal devices, or even contractual arrangements with other external computer facilities.

1.2.2 The Academic Computing Network

In order to accomplish the mission, CACS should seek to establish a distributed system of computers that utilizes existing capabilities in a coordinated service network, eventually ensuring each campus of the University direct onsite computer access. This requires establishment of a campus computing facility of an appropriate size and compatibility which may operate as a remote station to another University computing facility or as an independent computing facility for the individual campus, or in some cases both. Other separate and sometimes independent facilities may be continued, or new facilities established as program needs dictate and resources permit.

The suggested philosophy of academic computing, given a mission of providing University faculty and students access to computing services in the most efficient and effective manner, must be one of flexibility and service. In part, this may require the provision of stand-alone computing capability on many of our campuses. In other cases it may mean tele-processing devices for rapid communication. In order to realize the maximum benefit from the state dollars invested in computing equipment, we propose that a coordinated computing service be established in the University by linking together individual campus computing services as a single system that is flexible in design, responsive to user requirements, and considerably less expensive than other alternative approaches.

The proposed academic computing service will consist of existing computer equipment on various campuses augmented by new campus hardware and a central service staff responsible for the operation of remotely located computing stations on each campus. The coordinated service network will be built up over the next six years to service the expanding needs of students and faculty. On some campuses (e.g., Manoa Campus), it may be appropriate to establish several remote computing stations as educational needs dictate. It is intended that these computing stations be linked together so as to provide access from one to another.

Many independent computing facilities now exist (see Appendix D) and will continue to exist after establishment of the system even though the direction of University academic computing will be toward a coordinated network of computers. In many cases such independent computer installations offer the most cost effective solution to certain types of dedicated, task specific computing requirements, particularly with the introduction of mini-computers. In general, however, it is the intent of the recommendation that considerable economies may be realized by regarding all general academic computing in the University as part of a single system of academic computing services.

As pointed out by a consultant (see Appendix C) it is no longer cost-effective to buy the biggest possible main frame computer and force all users into the one computer as was common practice in years past. Advances in computer technology, particularly in micro-miniaturization of electronics, has resulted in considerable reduction of the effective cost of computing and of information storage and retrieval. These improvements, along with advances in systems design and programming result in a new concept of computer service. For many of our academic applications, the level of service can be considerably enhanced with the acquisition of several small machines operating in an interactive (timesharing) mode.

These new economics of computing are shifting management concerns from hardware expense to personnel expense. Indeed, personnel and related expenses at most computer centers now exceed hardware cost. As a result, attention is shifting from conservation of equipment charges to conservation of personnel expense. For this reason, we propose establishing a central academic computing staff to "manage and support" the various remotely located facilities that make up the computing service network in order to avoid staffing a number of different computer centers. The strategy for accomplishing central support of campus computing services is discussed in Section III, Long Range Computing Services Plan.

1.2.3 Governance of Academic Computing

The policies by which a computing center operates affect the staff of the computing center, the users in the academic community, and the academic administrators. These three groups must interact in a structured way if we expect to obtain a superior level of computing services appropriate to our position as a major state University. The function of an academic governance process is to ensure that each group has an opportunity to participate in appropriate decision making.

The day-to-day operation of an academic computing facility and the procedures and technology for delivering specific computing services are technical matters best dealt with by the academic computing center staff. The users, students, faculty and staff, should be provided a means for input at the policy level, a voice in determining the types of services to be made available, and a role in identifying the priorities for distributing computing resources. Academic administration has to evaluate competing academic requests for University funds, determine the level of funding to be provided for each type of academic support service and monitor the delivery of computing services to assure that they are provided to the users in a timely and effective manner. The ultimate management and allocation decisions rest with the academic administrators.

Since each campus has its own special academic computing needs and its own means of meeting these needs, the primary locus of governance interaction should be at the campus level. Therefore, we recommend that an Academic Computing Policy Committee be established on each campus. The campus committee should be selected by the campus executive officer from among the staff and faculty users based on recommendations submitted by the faculty senate and/or other equivalent campus organizations. There should be ex-officio representation from the campus computing center staff and the campus administration. Student representatives may be appointed as appropriate. The major function of the committee is to advise the campus executive officer and CACS on policies concerning the provision of academic computing services to that campus. In addition to the campus committees, we recommend that the systemwide Academic Computing Advisory Committee be continued but with new membership. The new ACAC should be selected from among the members of the campus academic computing committees. There should be ex-officio representation for the director of the Center for Academic Computing Services and for central academic administration. The committee should offer a reasonable balance among campuses in terms of the amount of computing services being used by each campus. The major function of the committee is to oversee the implementation of this plan, to recommend to the President or appropriate University executive officer policies related to the systemwide provision of academic computing services, and to recommend the appropriate level of resource requirements for these services.

It would appear that a similar structure is appropriate for administrative computing. We suggest that the University administration consider some parallel form of participatory user input and policy recommendation for the proposed center for information processing services.

Section 2

ASSESSMENT OF ACADEMIC COMPUTING NEEDS

2.1 THE NEAR FUTURE

It is the conclusion of the Committee that scientific and instructional computing in the future will be almost entirely terminal based. This is not to say that all computing will be interactive, or time-shared, in nature. Batch processing will be necessary in order to serve particular academic needs. However, there will be an increasing trend toward preparing batch jobs, submitting them for running, inquiring as to their progress, and browsing over their results, by means of terminals connected to an on-line, interactive system. This approach will make it possible for computer users to work in their immediate surroundings or wherever they choose, rather than trudging down to a distant computer center. In addition to convenience and labor savings, terminal based computing will save significantly on costs associated with unnecessary line printing, the purchase of cards and paper, and the unit record equipment necessary for handling cards.

It is in the context of this future computing environment that we have attempted to forecast future academic computing requirements for the various campuses of the University of Hawaii. The forecast and assessment of needs reflects user input from the three major segments of the University: UH/Manoa, UH/Hilo, and the Community Colleges. Because of uncertainty regarding expansion of West Oahu College, we have incorporated an estimate of their computing needs in the UH/Manoa forecast.

2.1.1 The Near Future at the UH/Community Colleges

Academic use of the computer is just beginning in the community colleges. Nonetheless, last year the community colleges utilized 22% of the time-sharing capacity devoted to instructional class use and more than 10% of the available academic computing service. Within the next six years, it is anticipated that academic use of the computer for community college instruction and other purposes will grow very rapidly as increasing numbers of faculty and students become familiar with the possibilities of computer applications in community college education.

2.1.2 The Near Future at UH/Hilo

Academic computing services at Hilo have been confined generally to batch processing through a remote-job-entry station linked to the University Computing Center. As a result, academic computing has been somewhat limited and UH/Hilo is at present using less than 5% of the central academic computing service. However, three recent events have initiated a different trend in instructional computing needs at this institution. First, faculty exposure to computer based education has had the effect of broadening the faculty's view of the wide applicability of computers. The exposure has stimulated considerable interest in using the computer as a significant problem-solving tool in the instructional process. Second, UH/Hilo recently acquired several time-sharing terminals that have been connected to the central computing facility. The availability of these terminals will increasingly change the nature of academic computing from the present batch processing mode to a predominantly time-sharing mode. Finally, other computers (microprocessors and mini-computers with accompanying terminals) have also been added to the campus. These additions are also contributing to the current re-direction of instructional computing towards an interactive mode.

Academic computing needs at UH/Hilo are expected to intensify during the next five years because of institutional growth and development. There has been and will continue to be institutional emphasis at UH/Hilo in two program areas that involve increasing use of computers: business administration and agriculture. Also, recent additions to the faculty have included persons with extensive training and background in computing and, consequently, have caused increased demands for computing support of instructional and research activities. In order to support these instructional and research activities, UH/Hilo has an immediate and critical need for professional computer personnel.

2.1.3 The Near Future at UH/Manoa

The Manoa Campus is currently the primary user of academic computing services. Manoa faculty and students utilize approximately 85% of existing academic computing services and have considerable need for more and better computing service for both research and instruction programs. In addition to basic research computing applications and considerable instructional computing, UH/Manoa is the University's center of computer science education and research. The recent study conducted by the UH/Manoa Senate Executive Committee's Ad Hoc Committee on Computer Policy (Appendix E) found considerable user dissatisfaction among both research and instructional users. Among the University campuses, Manoa represents the largest growth potential for academic computing.

2.2 INTRODUCTION TO THE NEEDS ASSESSMENT

2.2.1 Three Classes of Computer Capability

The following sections discuss the various types of service and outline what we believe to be a conservative estimate of the University of Hawaii's academic computing needs in the near future. For the purpose of projecting future academic computing requirements we have developed our forecast on the basis of required access (ports) to three different classes of computer capability:

1. Large Scale;
2. Medium Scale; and,
3. Small Scale.

The first class is *large scale* scientific computing. This class of service is essentially batch oriented for efficiency. The equipment providing the service should be capable of limited time-sharing, but any time-sharing done in this way should be permitted only for special purpose applications; e.g., large program debugging or because it cannot be done in an alternate way.

The second class of service is *medium scale* computing capability. This class of service is highly interactive time-sharing, and the equipment providing it should be specifically designed for that purpose. In terms of computing equipment currently available on the market today, we see the need for more than one such system by the end of five years. This capability will be used not only for most advanced on-line applications but also by the large scale scientific users for job preparation, submission, and intermediate results inspection.

The third class of service is *small scale* computing capability. Much of the instructional computing of the future can be placed at this level of service, and again we see the need for several systems. This class of service is also highly interactive, differing from medium scale service only in the size and nature of the jobs it is suited for handling.

2.2.2 Basis of the Forecast

The term "port" used throughout the forecast refers to an uninterrupted direct linkage to the computer from a separate device. Most remote stations are interactive terminals. For various reasons, not all terminals are actually using the computer at any one time. One of the advantages of timesharing is that multiple users can be serviced by the computer using the idle time between executions or processing commands. As a result, we think in terms of "ports" to the computer, where a port represents a connection between an active user and the machine. The relationship between ports and terminals is variable depending on location and distribution of the terminals and the nature of the computing activity. The estimates that follow assume that one port accommodates 60 hours per week of interactive computing. To obtain sixty hours per week of interactive computing on a single port may require one or more terminals depending on the use. Additional ports will be required to support remote job entry (RJE) stations. An RJE station is usually a small computer remotely located that communicates directly with the main computer.

The projections that follow are based on realistic forecasts and careful, thoughtful analysis of current use patterns. The practicality of funding has been considered in adjusting downward any optimistic growth projections. We have also attempted to be honest, but conservative, in assessing needs in order to provide a reasonable but minimum projection. We cannot assure the University that a computer system designed to meet these projections at maximum capacity will satisfy the future needs of the academic computer users. We can, however, assure the University that considerable dissatisfaction will arise if the minimum capacity needs projected for 1981-1985 are not met. In other words, we have attempted to project reasonable lower bounds in order to determine minimum computing needs. The maximum needs are, in the short run, bounded only by available resources.

2.3 FORECAST OF RESEARCH COMPUTING NEEDS

2.3.1 Types of Research Computing

Research computing in the University of Hawaii may be viewed in terms of four types of computing needs:

A. Scientific
B. Statistical
C. Simulation and Modeling
D. Computer Research

A. Scientific

Modern scientific computing is frequently characterized by large programs written in FORTRAN and requiring massive amounts of computation. Many applications require large scale computers. Additionally, scientific computing includes a considerable amount of software development as researchers explore new computational methods. This development work may or may not require large scale scientific computing facilities, but is often done using such facilities if they are available. Some development could be better done, however, on medium scale, more responsive equipment. The facilities needed to support scientific research computing include a large scale scientific computer providing batch access, and a medium-scale on-line time-sharing capability.

B. Statistical

Statistical computing is characterized by the use of pre-programmed comprehensive statistical computing packages such as SPSS. This category of research computing differs from the above mainly in that researchers do more "production work"; i.e., much less exploratory programming is done. The facilities needed are similar to those required for scientific computing. In addition, means for handling large volumes of data are required. On-line access may be important for initiating computations and inspecting intermediate and final results.

C. Simulation and Modeling

Simulation and modeling is characterized by the use of comprehensive simulation programming languages such as SIMSCRIPT and preprogrammed simulation packages such as GPSS. This work tends to fall between scientific and statistical computing with respect to the volume of programming that is done. Simulation systems are essentially large interpreters and thus require a high degree of computation to produce a given set of results. Again a large scale computing facility is needed. On-line access can be important, as this type of computation is highly exploratory; quick turnaround is often necessary for its successful use.

D. Computer Research

Research in computing is currently conducted by Manoa computer science and engineering departments. This research requires unique hardware and system software. Most computing research needs cannot be met with general use facilities which are intended to serve others reliably and dependably. Therefore, computing research departments should be expected to provide independent facilities for their special purpose research. Nonetheless, experience has shown that computing centers established solely for support of a general user community cannot be staffed adequately nor can the available staff adapt readily to constantly changing user requirements and technological advances without a minimal level of hardware/software research and development within the center. Therefore, some internal research and development effort is necessary within an academic computer center in order to maintain the vitality and appropriate academic orientation of the staff.

2.3.2 Research Computing in the Community Colleges

Although community college faculty have not traditionally engaged extensively in academic research, increasingly community college faculty are conducting research of the type usually characteristic of university faculty. In addition, community college faculty are encouraged to conduct research in areas related to instructional improvement. In order to serve their research computing needs, community college faculty must have access to computing facilities as do faculty at other campuses of the University, although it is not anticipated that the community colleges will have extensive need for large scale computers for research. This means that faculty will need occasional RJE access to a large scale scientific computer and periodic access to medium scale time-sharing facilities. In addition, the community college faculty will likely need access to facilities for educational research involving student follow-up studies.

2.3.3 Research Computing at UH/Hilo

Research use of computing services at UH/Hilo has been confined until recently to a remote job-entry (RJE) batch processing. However, it is expected that within the next few years, a significant shift toward interactive work will occur. As more terminals become available and as the faculty's technical expertise increases, the research users will take advantage of the data editing and computational processing power of on-line computing. Overall, there will be increasing research demands for computing services at UH/Hilo, especially in expanding areas such as agriculture, business, and social sciences.

2.3.4 Research Computing at UH/Manoa

The extent and magnitude of faculty research activity on the Manoa Campus (top 5% among U.S. universities) require full access to a large scale scientific facility. The Manoa Campus currently provides approximately $540,000 in external funding for support of research computing. With improved access and increased services, this figure could double in the next five years. In many academic fields, innovative technological advances and new computer applications to research occur daily. If UH/Manoa is to maintain its position among the nation's major research universities, we must improve the quality and quantity of computing services provided to research faculty.

2.3.5 Projection of Research Computing Services

On the basis of the above needs assessment, we estimate that within three years the University must service approximately 200 faculty and staff researchers on the Manoa Campus requiring an average of eight hours terminal time each week. This research equates to a demand of 1600 terminal hours per week. For research computing services, we estimate that each port will provide an average of 60 terminal hours per week, therefore, at least 26 ports will be needed for Manoa faculty. At UH/Hilo, we estimate approximately 25 staff and faculty researchers within three years requiring 3 ports for UH/Hilo faculty. At least one port must be available for community college faculty research, for a total requirement of 30 ports by 1981, increasing to 50 ports by 1985. Additionally, the University will need one or two small scale computing installations with peripheral equipment to support research in computing on the Manoa Campus. The growth and distribution pattern of these needs follow:

Table 2.1

Projected Number of Ports for Research Computing

	Fall 1979	Fall 1981	Fall 1983	Fall 1985
Large Scale Computing	5	9	12	14
Medium Scale Computing	12	21	28	35
Small Scale Computing	1	2	3	3
Total Ports	18	32	43	52

Staff Support for research computing is a critical need at present and will grow with increasing sophistication of computer applications. We suggest the phased development of a scientific programming and applications office to advise faculty and students on large scale computing problems. This staff could be supported, for example, from either direct research income or indirect research overhead. The service should be initiated by at least two senior scientific systems analysts/programmers and supplemented every two years with additional personnel as demand dictates. For planning purposes, we have assumed one additional person every two years. UH/Hilo will have need for a full-time resident scientific systems programmer by Fall 1981. The Community Colleges' needs will be met by central CACS staff.

2.4 FORECAST OF INSTRUCTIONAL COMPUTING NEEDS

2.4.1 Types of Instructional Computing

Instructional computing refers to computing done by students in connection with their course work. Instructional computing consists of three general types of computing applications:

A. Student problem-solving,
B. Adjunct to courses, and
C. Instruction in computing

A. Student Problem-Solving:

Student use of computers as a general purpose, problem-solving tool involves student prepared programs processed on small scale computers. Students write their own programs or select their own utility programs for use in connection with some course assignment. These programs are typically small, written in BASIC or FORTRAN, and run only once after they are developed. Since much of the work is one-time program development or execution, on-line computation is the most efficient delivery system. Facilities needed for these applications are one or more small scale, on-line computers.

B. Adjunct to Courses:

The use of computers as an adjunct, special-purpose, problem solver involves student use of existing programs selected by an instructor to do calculations in support of course objectives. Examples might be electrical engineering students studying filter design, business students studying complex time series, chemistry students exploring molecular properties, etc. Using prepared software, students focus on the effects of various parameters through computation manipulations that can only be done on a computer. Such computations can often be handled on small scale, on-line facilities, however, more advanced work requires medium scale computers.

C. Instruction in Computers:

Instruction in the use of computers takes many forms beginning with the development of computer awareness. This is often done without requiring students to write programs, such as through the use of computer games or information retrieval systems, or simply by discussion and example. Small scale, on-line facilities are sufficient for these purposes.

Several courses are offered throughout the University for the general user, e.g., for the student who expects to use the computer as a tool in later work but who is not interested in specializing in computing. There is also the need to accommodate students majoring in computing. Many computer science and engineering courses and increasingly business agriculture and some social science and humanities courses require students to have programming skills. A wide variety of necessary programming languages are available on large scale facilities. However, the volume of student users makes a good case for a medium scale facility because the critical need will be interactive responsiveness rather than voluminous computation. Since the individual computations are small; the variety of languages and the need for highly interactive computing would place a great and unnecessary burden on facilities not designed for such jobs.

There is also instruction about the use of computers in other fields. Examples are the use of computers in accounting, medicine, and design. Students in these areas may not require extensive computing facilities.

2.4.2 Instructional Computing in the Community Colleges

The primary and highest priority use of computers by the University Community Colleges is instructional computing. Among the Community Colleges, two major applications are instruction in the use of computers, and student problem-solving.

Computer science and data processing training programs currently exist at Kapiolani and Leeward Community Colleges. Although it is unlikely that additional computer science degree and certificate programs will be developed at other campuses over the next six years, courses are now offered at other campuses and the existing offerings may expand with increasing student demand. The current instructional programs require additional ports to accommodate increasing student access to computing services. Vocational programs in data processing and computer science will need access to representative computer hardware most commonly used by businesses in Hawaii. In this way, students' training will be most directly transferable to the job context.

Although the number of special vocational programs in this field will not increase, the growing utilization of computer technology throughout society creates a demand for general education courses to provide students in all fields with increased computer literacy. In addition, instruction in the use of computers will likely become a mandatory part of certain vocational programs (e.g., accounting). These new courses will create a demand for sufficient timesharing capacity to serve from 50 to several hundred students per semester on each campus.

Uses of the computer as a tool for problem solving and as an adjunct to courses in a variety of disciplines is increasing on most community college campuses. For example, a Honolulu Community College faculty member has developed a program to allow social science students to analyze survey questionnaires and other experimental results by computer. A computerized business simulation at Kapiolani Community College will serve several related programs in the business area. Mathematics instructors on several campuses are interested in placing computer terminals in mathematics labs to facilitate math drill and review. At Leeward Community College, accounting students are doing an accounting practice set on the computer.

To some extent, development of further classroom uses in the community colleges depends upon access to computing facilities and upon the exposure of faculty and students to others who are making use of this technology in their own discipline. Nonetheless, demand for timesharing capacity for community college instruction is projected to increase over the next few years, growing from a base of approximately 1,000 student users presently to 1,800 by 1985.

2.4.3 Instructional Computing at UH/Hilo

Instructional computing at UH/Hilo has been confined to a small number of courses relying on the batch processing of jobs through a remote-job-entry station. Events in the last two years, however, have created increased demand for computing services as well as a shift towards an interactive computing mode. The demand is particularly evident in the computer science, business, and social science programs at Hilo College. Additional need for instructional computing is anticipated for the vocational programs at Hawaii Community College and the academic courses at the College of Agriculture.

It is estimated that there are currently 400 student users accessing computing services, on the average, two and a half to three hours per week. Based on these estimates, there is an immediate minimum need for 18 ports. UH/Hilo's increasing usage of instructional computing services will require approximately 25 ports by 1983, growing to 33 ports in 1985. It is expected that these ports for instructional computing will require access to both small scale and medium scale computer capabilities.

2.4.4 Instructional Computing at UH/Manoa

Instructional computing at Manoa is growing rapidly with expanded computer applications in various disciplines. UH/Manoa has current needs for considerable computing capabilities to service general purpose instructional needs, special purpose instructional needs and the full spectrum of undergraduate and graduate instruction in the use of computers.

UH/Manoa is currently the primary user of instructional computing services. We estimate that there are currently about 2000 students with knowledge of computer use who would use, on average, only two hours per month for general purpose computing in connection with one or more University courses if facilities were available. This implies an initial need for 15 ports: four on medium scale and 11 on small scale facilities. With improving student and faculty computer literacy and competency, and spurred by the expansion of computers in various aspects of every day life, we expect these figures to double in five years.

In computer use instruction, there are currently 600 students enrolled in introductory courses at Manoa. We estimate these students should use an average of four terminal-hours per week. This translates to a need for 40 ports, 16 on medium scale and 24 on small scale facilities. We expect these figures to increase over the next five years by approximately 50% because of increasing interest in and new applications of computer technology.

There are currently 460 students enrolled in advanced computing courses. For these students, we estimate an average need each of five terminal-hours per week. Thus, for these students there exists an immediate need for 38 ports, 23 medium scale ports and 15 small scale ports. We expect this category to increase only 25% over five years.

2.4.5 Projection of Instructional Computing Services

It must be recognized that computer needs assessment is not linear in expansion. For example, the sum of the above needs for Manoa is 93 ports for instructional computing. However, there are economies of scale that occur as the number of ports increase, since more access is made available, and scheduling problems are smoothed out by large numbers of terminals. Therefore, we have adjusted the sum of the incremental forecasts to reflect these economies.

Student usage of terminals varies with the purpose or category of use, the students' level and discipline. We anticipate average usage time increasing as students become more adept at interactive computing, but that diminishing costs of software and hardward will compensate for this increase. The projection reflects an estimated base of 1,000 student users among the community colleges; 400 student users at UH/Hilo; and 2,800 student users at UH/Manoa. We anticipate differential growth and usage rates among the mix of students, and economies of scale as the number of terminals and ports increase:

Table 2.2
Projected Number of Student Users

	Fall 1979	Fall 1981	Fall 1983	Fall 1985
Community Colleges	1,000	1,200	1,450	1,800
UH/Hilo	400	500	600	750
UH/Manoa	2,800	3,600	4,400	5,000
Total	4,200	5,300	6,450	7,550

Table 2.3
Projected Number of Ports for Instructional Computing

	Fall 1979	Fall 1981	Fall 1983	Fall 1985
Large Scale Computing	0	1	1	2
Medium Scale Computing	63	75	87	103
Small Scale Computing	85	104	125	143
Total Ports	148	180	213	248

Staff support for instructional computing requires student help with professional supervision in addition to technical staff to maintain software systems and electro-mechanical equipment. The number and distribution of the staff will depend on the delivery strategy.

2.5 OTHER ACADEMIC COMPUTING NEEDS

In addition to basic instructional and scientific research computing, there are other aspects of University academic endeavors which rely on or are facilitated by computing services. These include instructional support services, computer assisted instruction, general faculty computing, departmental support services and electronic mail. These other applications and their projected impacts are discussed briefly below.

2.5.1 Instructional Support Services

Instructional support services refers to computation done by faculty in providing administrative support to their courses and their presentation of course material. Examples of computer applications which fall under this category include: gradebook management, test generation, test scoring, test analysis, personalized assignments (student prescriptions), progress monitoring, communication between faculty and students, course development, course organization, and development of software to be used by students.

Lack of access to computing facilities and insufficient computing support personnel on most University of Hawaii campuses has delayed use of computers for instructional support and computer managed instruction. A few faculty at Manoa have developed some systems to assist in course management and Honolulu Community College is pioneering in this area with a computerized test and record-keeping system in the social sciences. As computer facilities become more available and faculty become increasingly aware of the possibilities and advantages of instructional support services, we expect that demand for capacity for this purpose will increase.

Many of these computational services for instructional support can be performed on small scale on-line facilities. The nature of the data requires some degree of record and file security to maintain confidentiality of the information stored in the computer, but the problem is not significant and the development of certain central staff support services could facilitate these applications. Nonetheless, we expect that the growth in this area will be minimal until such time as staff resources are dedicated to developing systems and the fostering implementation of instructional support services.

Numbers are difficult to estimate since we currently have little use in this area. Some slight growth can be expected since most of the listed uses of this type of computing are currently taking place in at least some academic departments. We estimate that one port per 12 departments would be needed to meet the ultimate needs of the University; equivalent to meeting the requirements to service 400 course sections. We conservatively project the minimum need for one medium port and two small scale ports increasing to three medium scale and ten small scale ports in five years. Technical development and consulting staff are required along with student helpers.

2.5.2 Computer-Assisted Instruction

For the purpose of the Committee's deliberations, Computer-Assisted Instruction (CAI) is regarded primarily as an instructional technology rather than as a computing technology. As an instructional technology, it utilizes the computer as a communication medium in a special way that presently requires the considerable, if not total dedication of the computing system. We believe that CAI development should be considered separate from the paramount need for upgrading academic computing services. For this reason, the issue of the University's capability for providing CAI is addressed in section 5 of this report where an independent computing system for computer-based education is recommended.

Until such time as a separate computer-based education system is established for the University of Hawaii, some small level of CAI development and use will be ongoing through conventional academic computing services. It is estimated that the extent of this effort will require approximately three to ten ports by 1983.

2.5.3 General Academic Computing

General Academic Computing is included as a category to cover miscellaneous use of computing facilities by faculty and staff. For example, faculty and staff use computing in various ways: trying out ideas about subjects in their fields, making use of the computer as a problem-solving tool, and just gaining computer awareness. The impact of such computing is minimal for the next few years but may utilize two or three small and medium scale ports by 1981, doubling to approximately six ports by 1985.

2.5.4 Departmental Support Services

Departmental Support Services refers to computer support of academic department administrative activities. Such use of the computer usually falls into one of three departmental applications: (1) text editing, (2) operations analysis, and (3) administrative applications.

Potentially the largest area for departmental support computing is that of text editing, or word processing. Apart from classroom teaching, the outcome of most faculty effort is in the form of reports and publications. Our University environment, present and foreseen, does not offer extensive support to faculty and staff in this area. Text processing can significantly reduce the faculty's time and involvement in the production of such work and also provide a significant reduction in clerical effort required to produce final text. Single station, office oriented text editing systems are now being offered by vendors; however, more powerful text processing facilities are available on modern timesharing computers. While it is not clear that timesharing computers could be justified on the basis of the text processing capabilities alone, the text processing ability coupled with other computational power makes them economically attractive when compared to additional clerical staff or large number of single station office systems.

It should be recognized that text editing and processing systems offers considerable advantages over manual, clerical typing. As a result, we expect its use to grow rapidly over the next few years. If text processing is not available on a general academic computers, it is likely that before the end of five years there will be a considerable number of stand alone text processing systems on our campuses, purchased at a significantly higher price than the equivalent computer time which would have been used to accomplish the same result. Further, such independent systems would not be available widely to all areas of the University.

We suggest, therefore, that an institutional commitment be made to support text processing, coupled with careful control of the resources allocated for it to prevent too rapid a rush into the area. Sectors of the University user community are becoming familiar with the advantages of computer text processing and significant use is beginning to occur. Manoa's College of Business Administration is considering placing a terminal in each department office specifically for this application. It is only a matter of time before others follow suit. For these reasons, the University Administration should establish a task force to investigate this problem and recommend the best strategy for implementation.

In projecting the growth potential for text editing and processing we have assumed a ceiling on its use at about 36 ports maximum at any one time. It is not unreasonable to consider a demand of two or three times that number for the University system by 1985. Our assumption is that large scale growth of text editing will require special purpose computing equipment to service the demand. Such special purpose equipment is outside the scope of this present plan.

Another area of departmental support is operations analysis, which includes analytic applications such as departmental expenditure forecasting and management, and enrollment forecasting. If uniform systems were developed for these activities which served the needs of the individual departments, such matters could be moved into administrative computing. However, these activities are, and will probably continue to be, handled at the departmental or college level and tend to be different for each unit. The individuals involved in development of operations analysis applications are usually academic personnel; however, the impact or needs assessment is minimal.

The third area of departmental support covers administrative applications, including all other related departmental use of computing. As examples of current departmental applications in this area, several academic departments such as European Languages, Electrical Engineering, and the Law of the Sea Institute have developed systems for handling mailing lists and producing personalized form letters. Because many departments have significant problems at registration time caused by a lack of knowledge of upcoming course demands by the students, they are turning to the computer for assistance. Several University units such as the College of Business Administration at UH/Manoa and Leeward Community College have developed small systems for internal enrollment control and to monitor changes to enrollment after the beginning of classes.

2.5.5 Electronic Mail

Electronic mail refers to transmitting messages between individuals via computer terminals. Although this category belongs somewhere other than academic computing, we mention it here because the University's academic and administrative operation could be affected significantly by a good electronic mail system. For example, improving communication between various campuses, between administration and faculty, and between students and faculty. At present, a few individuals are currently using the timesharing system for these purposes.

A separate small scale on-line computer is sufficient to provide routing, filing, and retrieval of messages throughout the University. Although we believe this application should be pursued, it is not included in the forecast as a matter of priority.

2.5.6 Library Applications

The proposed automation program for the University library, while related to the academic programs of the University, is in our judgment an administrative task and a matter of concern for the administrative computing center. Library automation is therefore excluded, except that we note that the future reduction of academic load on the existing IBM 370 could possibly provide machine capacity for expanded library applications.

2.5.7 Projection of Other Academic Computing Services

Although the five areas discussed in this section are not significant in their immediate needs for time-sharing ports, these applications constitute a major growth area for future demand on computing services. Our projection of computing requirements assumes that because of scarce resources, the growth potential is dampened over the planning timeframe and is not fully realized until 1986 and beyond. Some management control may be necessary to assure the most effective use of available computing capability.

Table 2.5

Projected Number of Ports for Other Academic Computing

	Fall 1979	Fall 1981	Fall 1983	Fall 1985
Large Scale Computing	0	0	0	0
Medium Scale Computing	10	20	30	42
Small Scale Computing	2	6	10	16
Total No. of Ports	12	26	40	58

2.6 SUMMARY OF ACADEMIC COMPUTING NEEDS

As noted earlier in this report, there are economies of scale that occur when various needs are satisfied simultaneously. A conservative estimate of needs, therefore, is not the total sum of the individual computing requirements for each of the types of computing; but adjusted to something less than that total based on an assessment of the interaction between the various category of uses. For this reason, the adjusted forecast in the tables following should be regarded as a discounted sum of discounted sums. It must be considered as a conservative estimate of minimum future requirements. Actual or maximum requirements could be as much as 50% to 80% higher.

2.6.1 Forecasted Minimum Number of Ports

Our analysis of academic computing requirements covers four dimensions of computing services: type of computing requirement, size of computer, segment of the University and time. The tables following summarize the previous discussion of academic computing needs by the various dimensions of need and implementation. Time is held constant at Fall 1985 for all cross tabulations except for those tables that forecast computing needs over time.

The forecast of minimum computing needs among the University of Hawaii campuses is based on current technology available today in the computer marketplace. The experience of the past decade is testimony to rapid technological change that occurs in this field. A technological breakthrough, a new application, a major improvement in software can all impact severely the needs assessment and resulting forecast over the next six years. Such changes can possibly increase demand radically or possibly increase capability by an order of magnitude. In any case, we recommend that this forecast be reassessed annually and updated to reflect changing needs, demands, and technology.

Table 2.6

Adjusted Forecast of Minimum Computing Needs by Type of Use

	Research Computing	Instructional Computing	Other Academic Computing	Adjusted Forecast Of Ports
Large Scale Computing	13	2	-0-	15
Medium Scale Computing	33	97	40	170
Small Scale Computing	3	133	14	150
Total No. of Ports	49	232	54	335

Table 2.7

Adjusted Forecast of Minimum Computing Needs Over Time

	Actual* Fall 1978	Fall 1979	Fall 1981	Fall 1983	Fall 1985
Large Scale Computing	0	4	9	13	15
Medium Scale Computing	56	80	110	135	170
Small Scale Computing	69	85	109	130	150
Total No. of Ports	125	169	228	278	335

* For comparability we regard current available TSO and APL as medium scale computing, existing (2) DEC 11's and HP 2000 as small scale.

Table 2.8

Adjusted Forecast by Minimum Computing Needs by Campus

	Large Scale Computing	Medium Scale Computing	Small Scale Computing	Total Forecast
Community Colleges	2	19	62	83
UH/Hilo	2	16	20	38
UH/Manoa	11	135	68	214
Total No. of Ports	15	170	150	335

Table 2.9

Adjusted Forecast of Minimum Campus Computing Needs Over Time

	Actual Fall 1978	Fall 1979	Fall 1981	Fall 1983	Fall 1985
Community Colleges	33	43	65	75	83
UH/Hilo	14	22	28	34	38
UH/Manoa	78	104	135	169	214
Total No. of Ports	125	169	228	278	335

Section 3

LONG RANGE PLAN FOR ACADEMIC COMPUTING

3.1 THE GENERAL PLAN

The Committee's approach to developing and implementing a plan for servicing the University's academic computing requirements is to analyze the needs, define specifications for an appropriate baseline computer system, solicit vendor proposals based on our baseline system, and proceed with the acquisition of a computer system which most closely meets our specifications and is within our budget. Staffing and physical facility requirements are briefly discussed. The plan calls for an orderly transition from the existing shared IBM 370 computer to new academic computing facilities, assuring adequate user conversion and training periods and availability of a substantial library of the most commonly required programming languages and computer software packages. Presented in this section are the schedules for the implementation of a system of computers and the formation of an organization to coordinate and operate basic University academic computing services.

3.2 PROCUREMENT CONSIDERATIONS

The acquisition process is scheduled to begin immediately in order that procurement can take place in calendar 1980. Generally, the academic computing system will be developed in three major increments or phases. The first phase will be implemented immediately in the next biennium (1979-81) while the remaining two procurement phases have been projected during the fiscal biennia of 1981-83 and 1983-85.

The specifications for the acquisition of a time-sharing computing system are being developed by the Computer Center staff concurrently with this Long Range Plan to be released by July 1, 1979. Generally, the specifications will call for *essential* and *desirable* items. *Essentials* are specifications which must be met by the vendors; e.g., number of ports serviced, selected programming languages, etc. It serves as a first level of review for eliminating proposals from further consideration. *Desirables* are items of lesser priority and are items by which proposals that have met the *essential* specifications will be further evaluated.

The Committee believes that considerable savings will result from a single procurement for the entire system. Estimates run as high as 50 per cent savings. In addition, a single vendor for the system will mean considerable savings in personnel costs, interfacing components, and interchanging service capacity. It should be noted that the Committee recognizes the possibility of a vendor incorporating both timesharing and CAI as part of the vendor's proposal. Although the Committee has chosen to consider the procurement of each as separate items, this decision is not intended to preclude a vendor from proposing a joint system as an alternative to the basic timesharing proposal.

3.2.1 Procurement Activities

Some of the staff efforts and activities involved in developing the proposed hardware specifications for the new computer system are listed below along with suggested schedule dates.

Mar 1979	Continue to review general user requirements. Look at all user requests, summaries of the 1976 User Survey, the 1976 Timesharing Survey, and the 1978 User Survey -- also review all user comments submitted in those surveys. Continue to accumulate user comments.
Apr 1979	Define general specifications and acquisition plans.
May 1979	ACAC review preliminary specifications.
May 1979	Provide an open announcement to all vendors regarding our requirements and inform them of our intentions. Advise them that we intend to issue a request for proposals in the next few months. Inform them that we are in the information gathering phase now and are trying to finalize a proposal so that we can expedite procurement when approval is given. Request information and support materials from the vendors. Include request for list of installed sites, names of contacts, etc.

May 1979 Pending official approval from the University to proceed, need to know cost and budget limitations. Although we don't want to proceed with vendor presentations and get information too early, initial feedback from vendors will facilitate our subsequent procurement planning.

Jun 1979 Technical presentations by invited vendors.

Jun 1979 Review and finalize specifications with updated information. Details of the preliminary specifications will be reviewed by ACAC prior to release.

Jul 1979 Formal request for proposals. Establish ACAC procurement review subcommittee.

Sep 1979 Evaluation of proposals.

Sep 1979 Visit selected vendor installations.

Sep 1979 Benchmark tests.

Oct 1979 Final selection of vendor.

Feb 1980 Installation of first segment.

3.3 PLANNING SCHEDULE FOR AN INTEGRATED COMPUTING SYSTEM

The minimum computing services necessary to support the academic programs of the University of Hawaii campuses were analyzed in detail in Section 2 of this report. This section addresses the planning and procurement of hardware to service the campuses. It is assumed that the level of computing service must be above the identified minimum levels.

3.3.1 The Tentative Planning Schedule

The schedule shown in Figure 3.1 is tentative pending administrative review and action. It is included as the planning basis for subsequent acquisition schedules. The detailed analysis of Figure 3.1 provides a clearer picture of the necessary procurement to meet the minimum service needs and develop the proposed system of computing services. The various proposed installations are described in Figure 3.1 as separate timesharing computers capable of providing local small and medium scale timesharing. This representation is convenient for the purpose of describing an integrated system of computing services and for developing estimates of staff and equipment costs. The final system may be configured quite differently depending on the vendor proposals. Our intent is to provide to each campus of the University sufficient computing capability to service the basic computing needs of their academic programs. In some cases that service will be in the form of a resident computer, in other cases it may be in the form of electronic linkage to a remotely located computer. Figure 3.1 provides a summary of the phasing schedule and arrays one possible alternative to achieve the level of computing services necessary to support the academic programs of the University.

The following discussion of proposed acquisitions of hardware is based on the current state-of-the-art for computer hardware and software. The actual number and distribution of computing facilities may change should significant factors change in the course of hardware procurement; for example, a major technological breakthrough.

3.3.2 Phase I; 1979-1981

The minimum projected need for Fall 1979 is 169 ports to provide the basic computing services necessary to meet the computing requirements of the instruction and research programs. 100 new ports are planned for UH/Manoa as the initial increment in the plan. All campuses will have access to this new capability

Figure 3.1 TENTATIVE PLANNING SCHEDULE (In Constant 1979-80 Dollars)

	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
Computer Acquisition						
UH Manoa	TS+100 $150K (5 mos.)	$300K→ HP+32 -0-	HP+32 -0-			T/S+100 $300K→
UH Hilo			S+32 $80K			
UH Community Colleges		S+16 $50K; S1+16 $50K	S+16 $50K	S +32 $80K	S+16 $50K; S+16 $50K	△16 $30K
Center for Academic Computer Services			B A T C H $150K	+15 $600K→		
No. of Local Ports						
UH Manoa	100	132	164	164	164	264
UH Hilo	14	14	46	46	46	46
UH Community Colleges	33	65	81	113	145	161
Center for Academic Computer Services	-0-	-0-	-0-	15	15	15
Total System	147	211	291	353	380	501

along with access to the present system through existing ports -- 37 (average) on the 370 and 32 on the HP. The distribution of required ports indicates that a medium-scale timesharing capability is essential for the first phase to service academic computing needs. Multiplexers may be installed at the various community college campuses to tie them into the new timesharing system.

In the second year of the biennium, three additional sites will be added: a second UH/Manoa installation using perhaps a small computer such as the HP with 32 ports and two small 16 port computers for the community colleges. Exact placement of the installations will be determined at a later date in conjunction with the appropriate chancellor.

It should be noted that as the anticipated number of student and faculty computer users expands from 12,000 in 1978 to over 24,000 in 1985, we must plan for the distribution of Manoa Campus user traffic away from the already overcrowded Keller Hall. This can be done by establishing RJE/timesharing sites at strategic locations around the campus and by using small-scale computers remotely located about the campus to accommodate the necessary expansion of UH/Manoa ports.

During Phase I, the Center for Academic Computing Services (CACS) will be established to operate the Manoa Campus facility and provide professional support services to all academic users throughout the University. The total staff of 15 people includes at least 10 existing staff. The actual number of staff to be transferred from the present UH Computing Center is a matter for the central administration to work out after approval of this plan.

We have proceeded with our planning on the basis of minimal staffing in order to provide marginal cost estimates.

3.3.3 Phase II: 1981-1983

It is assumed that by the Fall of 1981 the majority of the timesharing workload will be shifted from the IBM 370 computer to the new academic computing service. The forecasted minimum need by Fall of 1981 is 228 ports, i.e., 128 additional new ports allowing for the phase out of the IBM 370 as the primary academic computer. This will provide for interim growth requirements and permit the IBM 370 timesharing users time to convert most of their programs to run on the new computing service. The medium scale computing facility may need to be upgraded (ports, memory, disk storage), and an additional small scale computing facility will be installed on UH/Manoa. Additional timesharing expansion planned during this period includes small scale computing installations at UH/Hilo (32 ports) plus two additional community college installations.

In early 1982 a new batch oriented capability will be added to academic computing services, thereby freeing the IBM 370 for full-time administrative work. The Committee recommends that a committee similar to ACAC develop a long range plan for administrative computing so that phasing of computer acquisitions may be coordinated.

The new academic batch processing installation will provide large scale computing services that are vital to the support of major research projects. This system will handle the batch requirements for long running jobs, those with considerable and/or special printing requirements, and will also process jobs with magnetic tape requirements. It is expected that former IBM 370 academic batch users will convert their programs to the new academic batch service. This new batch processing service will be part of the academic computing network. Also, it is assumed that the IBM 370 will continue to be available for occasional, special purpose academic applications. In the second year of the biennium a 32 port installation will be established on one of the community college campuses and staff support will be expanded to support the new installations.

3.3.4 Phase III: 1983-1985

The forecasted minimum need for computing services by Fall 1983 is 50 additional ports for a total of 278 ports in the network. Most of this increase will be met by adding two additional installations at the community colleges. The large scale academic batch computer will be upgraded to handle the normal increase in workload and the added workload of those continuing to convert from the IBM 370.

In preparation for increasing academic uses of medium scale computing, a second medium scale timesharing/RJE station will be installed at UH/Manoa and a community college installation will be upgraded during 1984-85. The expected capacity at this time will be 486 ports serving approximately 24,000 students, staff and faculty users, representing over 50% of the potential user population.

3.4 PHYSICAL FACILITY REQUIREMENTS

3.4.1 Immediate Physical Planning Concerns

We recommend that planning begin immediately to locate a full-service computer facility on the Manoa Campus. Needed by February 1980 will be a building that provides a computer room for the time-sharing installation, user work area and staff offices. Initially this will require approximately 1200 square feet but will rapidly expand.

In addition, there is considerable user dissatisfaction at UH/Hilo regarding the present site of the computing facility. The bulk of computing services at UH/Hilo, including the remote-job-entry station, are located on the Hawaii Community College (HCC) campus. However, the vast majority of instructional and research users (students and faculty) are located on the Hilo College and the College of Agriculture campuses, one-half mile from the HCC campus. The long range physical development plan for UH/Hilo projects the relocation of the HCC facilities to the main UH/Hilo campus. For these reasons, UH/Hilo may wish to consider immediate relocation of the computing facility to the main campus in order to alleviate this problem.

The University has attempted to acquire additional space since 1967 in capital improvement program (CIP) budget requests and memoranda. We recommend the University take action to insert as a high priority in the capital improvement program a request for a permanent University computing facility of approximately 20,000 square feet to house the batch processing system and CACS. This facility will be needed by 1982 to provide a computer room, central users work area, staff consultants room, class and conference rooms, computer output distribution areas, storage areas, ancillary equipment room and a central computer reference library.

3.4.2 Future Physical Planning Concerns

Additional computer facilities and staff offices will be required for each of the site installations on UH/Manoa, UH/Hilo, and the community colleges. Each site should be approximately 120 to 600 square feet depending on the installation. Raised floors, air conditioning, electrical power, data communications wiring and ducts must be planned for. In addition to space for the computer installation at each of the sites, user work areas, output distribution areas, storage areas, terminal rooms, and staff offices must be planned for.

Section 4

PROPOSED STAFFING AND EXPENDITURE SCHEDULE

4.1 STAFFING REQUIREMENTS

The minimum staffing requirements projected for the future computing services organization are discussed in this section. For planning purposes, the current UCC Technical Services support staff are assumed as the base staffing and the positions described are new ones required to meet the service needs of the academic programs and to provide basic support to the campus academic computing installations. By 1983, a functioning center for Academic Computing Services must have adequate staffing for office support, user services, research and development, systems programming and computer operations support. Individual campuses may choose to provide additional computer staff as their needs dictate and priorities warrant.

4.1.1 Office Support

Office support refers to the CACS administrative functions. Included here are executive management, secretary, fiscal administration and other staff positions. Briefly, this group is involved in computer accounts management, bill collection and payment, purchasing, operating budgeting and control, personnel management, reception/telephone answering, records and the preparation of CACS managerial reports.

4.1.2 User Services

The user services include all user education, staff consulting, and other support activities. User education involves conducting seminars and short workshops to instruct staff, faculty and students in the use of various computing services and new developments as they occur. A circuit rider team should be established to ensure regularly scheduled workshops for all campus sites.

An important part of User Services is staff consulting. This involves assisting academic users in resolving difficulties encountered in the development and use of computer software (interpreting computer error messages, etc.). Essentially two main categories of consulting should be provided: short-term consulting, and long-term/ special applications consulting. Short-term consulting is for common, easily resolved difficulties and is accomplished by student and staff consultants located in the user area. Our studies indicate that there is a critical need to expand the present consulting service to evenings and weekends to accommodate the increasing number of academic users. Long-term/special applications consulting is done by staff specialists who are experts in various aspects of academic computing. For example, statistics is one of the major academic applications and its use continues to grow. And yet, the University of Hawaii does not provide a statistical computing expert to assist users in analyzing their needs to recommend the appropriate software, and to assist in the interpretation of results. A full-time specialist in graphics applications is required to advise faculty and staff in the use of this important computer tool. Support is required in the mathematical/simulation area. We need a specialist to provide more in-depth assistance. One specialist may be required for data base support. Assistance in this area has been requested by many users of large data bases.

The user Services category of "other support" includes contract programming, data entry service, network services, reference library and user communications. Contract programming involves a pool of consultant/programmers (generally student assistants) who accept programming and system design projects from academic users on a cost reimbursement basis. Data entry services are basically the user's responsibility. It is expected that some users may need occasional data entry support and a small service should be established for this purpose on a fee-for-service basis. A total service concept desired in this area would include optical scanning services and the overseeing of the user's jobs from data entry to the submission of data anlaysis programs for that data. Network services involves the research/management of terminals/micros, multiplexors, port switchers, special data communications interfacing, and other data communications equipment. Reference library services involves the central maintenance of computer reference manuals for users and staff use. User's references must be placed in readily accessible places, i.e., in the user work areas at the main center and at the various sites. The technology explosion in computing over the past decade has created an extensive body of literature including manuals, periodicals, references, and texts. User communications involves the timely production of newsletters and other bulletins to keep users informed of policy, schdule and other procedural changes.

4.1.3 Research and Development

The vitality and professional capability of an academic computing organization rests in part with the staff's ability to participate in the advancements of technology as they occur. Most academic computer centers at major universities maintain a small research and development staff working on the frontier of applied computer technology. In this manner they stay current with the various hardware and software advances, and contribute new internal developments to the overall computing services. Research and development staff also contribute to computing services in other ways, for example, research and development is presently needed for the integration of microcomputers into the systemwide computing service as distributed processors. Proliferation of micros throughout the University has already begun (see Appendix D) and a central coordinating effort may be appropriate. The increasing power and capabilities of these microcomputers at significantly reduced cost will soon require consideration of their role in the development and growth of the systemwide network of computing services.

4.1.4 Systems Programming

Systems programming involves the generation, maintenance and special modifications to the operating system of the computer. This group will coordinate the computer systems programming activities for all computer installations that are part of the academic computing services system. The systems programmers will also be responsible for special programs requiring internal linkages to the computer operating system, e.g., online accounting and record security.

4.1.5 Computer Operations Support

Computer operations support refers to running the various computer installations and providing other on-site services. The small scale computer installations at the various campuses will require little operator attention since they are expected to be able to run unattended most of the time. Nonetheless, they must be monitored by onsite staff. Handling material from the computer printers, coordination of user input, and facilitating computer processing are all tasks that are part of computer operations support.

4.1.6 Summary of Staff Requirements

The following table describes the minimum staffing needed to support the activities of the Center for Academic Computing Services and the remote computer installations at the various campuses. Tables 4.1 and 4.2 describe the estimated minimum professional staff for instruction and research computing by campus. The summaries following include both University APT professionals and civil service operations support personnel. In addition these full time staff, student personnel and faculty consultants will be necessary to provide the full complement of personnel to operate the academic computing system.

Table 4.1

Central Personnel by Campus and Function (Fall 1985)

	UH Manoa	UH Hilo	Community Colleges	CACS Staff	Total Staff
Office Support	2	1	--	3	6
User Services	4	2	6	5	17
Research & Development	1	--	--	2	3
Systems Programming	--	--	--	2	2
Computer Operations	6	2	6	10	24
Total Staff	13	5	12	22	52

Table 4.2

Phasing of Central Personnel by Function

	Fall 1979	Fall 1981	Fall 1983	Fall 1985
Office Support	3	4	5	6
User Services	6	11	15	17
Research & Development	1	2	2	3
Systems Programming	1	2	2	2
Computer Operations	4	9	21	24
Total Staff	15	28	45	52

4.2 EXPENDITURE SCHEDULE

The proposed expenditure schedule is shown in Tables 4.3 and 4.4 following. They list the total funds in 1979-80 constant dollars, to equip and staff a minimum level of basic computing services. Resources for computing services are intended to be distributed among UH/Manoa, UH/Hilo, the UH/Community Colleges; but under central coordination by the proposed Center for Academic Computing Services (CACS). Campus administrators may elect to expand the basic level of service by allocating campus resources for additional computing equipment and staff to meet the needs of their respective campus programs.

Funds currently allocated to the existing University Computing Center (UCC) are not included in these totals; the procedure for the transfer of staff and equipment from UCC to CACS is beyond the scope of this report. The committee suggests that assignment of resources for academic and administrative computing support is an administrative matter to be determined when this plan is implemented.

Table 4.3 shows the proposed expenditure schedule for staffing and equipment. Table 4.4 provides summary details in the following categories: A-fund (personnel); B-fund (current expenditure); and C-fund (equipment). Personnel rates (A-fund items) are based on \$22,000 average for administrative and professional computer staff and \$14,000 average for operating personnel. The expenses for computer acquisition are listed under the B-fund category. It should be remembered that the long range plan does not refer to the acquisition of specific numbers of computers, but of computing services. Such services may be provided by a computer at each campus or they may be provided through campus access to a set number of ports.

The following purchase and leasing costs are used for planning purposes to develop cost estimates. These estimates must be regarded as tentative pending final review of vendor submittals.

a) Large scale batch system with limited timesharing:

$600,000 annual

b) Medium scale timesharing service of 100 ports:

$300,000 annual

c) Small scale service capable of supporting up to 32 ports:

$80,000 purchase (32-port)

50,000 purchase (16-port)

Items listed in the C-fund category include small ancillary equipment and office furniture to be purchased.

Table 4.3 Personnel and Computer Acquisition
(In Constant 1979-80 Dollars)

Personnel*	1979-80 Cons	1979-80 Op	1980-81 Cons	1980-81 Op	1981-82 Cons	1981-82 Op	1982-83 Cons	1982-83 Op	1983-84 Cons	1983-84 Op	1984-85 Cons	1984-85 Op
UH-Manoa	2	2	2	4	3	4	5	4	5	4	7	6
UH-Hilo	–	–	–	–	1	1	1	1	1	1	3	2
UH-Community Colleges	–	–	2	2	3	2	4	3	6	6	6	6
Center for Academic Computing Service	9	2	9	2	12	2	12	10	12	10	12	10
Total Personnel	11	4	13	8	19	9	22	18	24	21	28	24
New Positions Assuming Minimum Transfer from Computing Center	3	2	5	5	11	5	14	12	16	15	20	18
Total Annual Personnel Expense	$ 94,000		$180,000		$312,000		$476,000		$562,000		$692,000	
Computer Acquisition												
UH-Manoa												
(1) 100-Port Service	$150,000		$300,000		$300,000		$300,000		$300,000		$300,000	
(2) 100-Port Service	—		—		—		—		—		300,000	
UH-Hilo												
(1) 32-Port Service	—		—		80,000		—		—		—	
UH-Community Colleges												
(1) 16-Port Service	—		50,000		—		—		—		—	
(2) 16-Port Service	—		50,000		—		—		—		—	
(3) 16-Port Service	—		—		50,000		—		—		—	
(4) 16-Port Service	—		—		—		—		50,000		—	
(5) 16-Port Service	—		—		—		—		50,000		—	
(6) 32-Port Service	—		—		—		80,000		—		—	
(7) Upgrade to 32 Ports	—		—		—		—		—		30,000	
Center for Academic Computing Service Large Scale Batch Service	–		—		150,000		600,000		600,000		600,000	
Total Annual Expenses	$150,000		$400,000		$580,000		$980,000		$1,000,000		$1,230,000	

* Minimum personnel needs are forecasted in two categories: "Cons" refers to professional staff consultants and similar APT positions; "Op" refers to operators and other civil service personnel.

Table 4.4 Projected Expenditures
(In Constant 1979-80 Dollars)

	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85
(A) Personnel	$ 94,000	$180,000	$312,000	$ 476,000	$ 562,000	$ 692,000
(B) Supplies & Computer Hardware	150,000	400,000	580,000	980,000	1,000,000	1,230,000
(C) Other Equipment Purchase	50,000	10,000	10,000	10,000	10,000	10,000
Total	$294,000	$590,000	$902,000	$1,446,000	$1,572,000	$1,932,000

4.3 RESOURCE ALLOCATION POLICY

Our recommendation is that the basic level of computing support to the academic programs be provided from centrally allocated resources. The intent of this report is that academic computing services should be made available to the entire University of Hawaii academic community. The Committee's objective is to provide an easily accessible academic support facility comparable in many ways to the library-- indeed, as important to some disciplines as the library is to others.

Once again we emphasize that the staffing and resource projections are for minimal support. The projections assume that individual campuses may augment the CACS centrally funded personnel. The staffing strategy is to provide a basic level of computing services. Any enhancement beyond the basic level of service to a particular campus should be reflected in the campus priorities as determined by the allocation of campus resources. Thus, some campuses may decide to enlarge the computer role in their academic programs by increasing the number of local ports and acquiring more computer personnel. Others may choose to use their resources for other academic purposes. The choice is left to the campus.

It is our recommendation that service fees be charged only to special purpose users such as sponsored research. Any funds collected should be used to acquire additional personnel and equipment to supplement the basic level of computing service and to make up for the loss of general computing services as a result of special purpose user services.

Section 5

COMPUTER BASED EDUCATION

In the past two decades, computers have come to play an increasingly significant role in the total educational process. To address this important area of concern, ACAC formed a subcommittee to investigate the outcomes of the University CBE Pilot Project and to recommend a future direction for the University of Hawaii. This section provides some background information, a description of the various instructional uses of computer resources, and a recommended level of commitment the University should make toward computer-based education (CBE). It is based on the final report of the ACAC Subcommittee on Computer Based Education.

5.1 INSTRUCTIONAL USE OF COMPUTERS

There are four major types of instructional use of computers:

(1) the teaching about computers as a subject (i.e., Computer Science);

(2) the use of the computer as a problem solver (and the teaching about computer problem solving);

(3) the use of the computer as a teacher or tutor of various subjects (referred to as Computer Assisted Instruction or CAI); and,

(4) the use of the computer to help the instructor "manage" instruction and maintain class records (referred to as Computer Managed Instruction or CMI).

The first and second areas have been addressed in earlier sections of this report. CMI has been successfully implemented on a number of different computer systems (H/P Basic, DEC Decal, APL implementations, and CDC PLATO) which provide this capability at a good to excellent level. For this reason, only the area of CAI is addressed, where significant differences in capabilities exist among alternative systems.

5.2 MAJOR QUESTIONS CONCERNING CAI

A primary concern of the Committee was whether the value and potential of CAI warrants the allocation of considerable University resources. The major questions asked by the subcommittee included:

1. Under what circumstances can CAI be effective?
2. Can CAI be implemented on existing computer systems at the U.H.?
3. What kind of acceptance has CAI received in educational institutions to date, and what is the prognosis for the future?
4. What are the educational or academic advantages of a CAI system?
5. What would be the cost of CAI and what benefits could be expected?
6. What are the likely consequences of holding off on a CBE/CAI decision for two to three years?

5.2.1 Effectiveness

There has been an increasing number of articles and research experiments dealing with CAI in the past three or four years, indicating growing interest in the subject. The 1977 publication, Academic Computing Directory, by the Human Resources Research Organization (HumRRO) of Virginia identified over 350 American schools, colleges, and universities that have used CAI successfully. Some of the reasons given for adopting CAI demonstrate why CAI-related learning can be useful: 1) evidence of increased student achievement; 2) evidence of increased institutional productivity; 3) a variety of applications in many subject areas and courses; and 4) the teaching of computer literacy. An additional factor that is always mentioned is the positive impact that CAI has on student attitudes toward learning.

In comparisons of the effectiveness of CAI relative to traditional instruction, the conclusions are positive but mixed. In a review of this comparative research, Kulik and Jaska (1977) reported that in 45 percent of the studies, CAI was more effective (higher student achievement) than traditional instruction. The remaining studies showed little or no difference between the two approaches, or mixed results. Educational Testing Service conducted large-scale independent evaluations of two CAI systems, PLATO and TICCIT, during 1977-78. Each of these evaluations reported both positive and negative results. On PLATO, although there was no significant difference in student achievement (as measured), both faculty and student attitudes toward the system were highly favorable; and 90 percent of the faculty studied planned to continue to use PLATO to supplement their classroom instruction. The TICCIT evaluation showed improved student achievement, but lower completion rates. Other studies of TICCIT (English) have indicated both improved performances and higher completion rates.

The University of Delaware has reported in their "Second Summative Report of the Delaware PLATO Project" (July 1977) that controlled experiments in both music and languages (Latin) during 1976-77 showed positive results for the PLATO groups over the control groups. More recently, dramatic gains in achievement have been attained as a result of the use of the PLATO-delivered BASIC SKILLS LEARNING SYSTEM in a variety of educational settings. All these studies confirm that CAI can be effective if properly designed and implemented. In the studies where CAI did not prove more effective than traditional instruction, the reasons often identified were poor planning, faulty implementation, or inadequate support for the effort.

When students have shown improved performance under CAI methods, it can usually be attributed to a number of factors: 1) the student receives 100 percent attention when interacting with the computer courseware, while in traditional methods the amount of attention from the instructor or tutor is often much less intense; 2) individual attention on all aspects of instruction is possible through CAI methods for every student, while it is not possible in traditional methods; 3) the student in CAI instruction is not exposed to the errors of other students and his own errors are instantly recognized and correctable; and 4) the student becomes personally involved in CAI instruction and there is an active, productive interaction between student and computer.

5.2.2 Efficiency

One of the more prominent and recurring outcomes of studies of CAI is that it takes less time for students to learn in this mode. Some of the early estimates of time saved ranged from around 20 percent to as much as 50 percent (KULIK & JASCA, 1977). In the case of the BASIC SKILLS LEARNING SYSTEM, the outcomes show as much as 80% reduction in student learning time. However, the quality of the lessons is the crucial determiner of the degree of efficiency.

Dr. Patrick Suppes of Stanford reported his ability to handle twice the number of courses without a corresponding workload increase, by utilizing CAI methods in some of his courses. In the "Third Summative Report of the Delaware PLATO Project," November, 1978, a description of the implementation of CAI into a bio-mechanics course at the University of Delaware showed a significant reduction in the amount of time students spent on a project.

It should be noted that many of the published studies contrast only drill and practice or tutorial formats against traditional instruction. The simulation format, on the other hand, may be the only economical way of presenting some instruction. In view of the information explosion, simulations may be more effective than other educational formats for teaching students to deal with new situations and to apply various steps in decision making and in open-ended problem solving. It appears that a computer-assisted learning environment is the only efficient way to deal with simulations on a large scale.

5.2.3 Educational Advantages

In addition to the potential for higher achievement rates and greater efficiency, CAI offers other potential advantages which are more difficult to quantify. There is the possibility of offering education in remote, isolated areas. In situations where it may not be feasible for students to have daily contact with an instructor, a terminal could be used for day-to-day interaction and learning and the instructor could meet the class weekly or at some other regular interval. There is the convenience factor to working students who could not get to a class or to the institution at the time a course is offered. Terminals, located at libraries or schools around the island, could be made available to such students, for supplemental instruction. Furthermore, in addition to being (potentially) available 24 hours per day, CAI offers some capabilities (e.g., simulations, complete accuracy, large data bases) that are not possible in any other presentation mode.

Computer instruction has the capability of incorporating other variables that are often considered important for effective learning and retention. First, properly constructed CAI provides clear statements of the objectives for the instructional lessons. The student is informed as to what is to be learned; and this information serves to facilitate the learning process. Second, CAI requries the active participation and involvement of the student in the learning process. The student must respond actively in both cognitive and non-cognitive modes, and this involvement is known to enhance learning and retention. Third, CAI provides immediate feedback to the student as to whether he has actually learned the material. The feedback reinforces the acquisition of correct information and skills and provides information for the correction of errors. Finally, CAI provides individualized instruction with self-pacing and subprogram branching features. This capability allows for the accommodation of student differences in learning rates and learning styles, and hence increases the probability that all students will learn.

Some of these features of instructional design are, of course, common to other educational approaches such as the unit mastery system; however, the technological superiority of the computer clearly permits more effective implementation of the total range of these instructional components. For example, relative to a human instructor or tutor, the computer provides more consistent instruction to students and more immediate feedback to all students. In addition, the computer can provide certain kinds of instructional activities that would be difficult or impossible to duplicate with other educational approaches. In particular, simulation exercises permit learning in situations that approximate reality, while eliminating the real-life problems of time expenditure, lack of resources, and possible danger. Specialized chemistry experiments requiring expensive facilities, and genetics experiments which could not be completed in a single-semester course are examples. Finally, the fact that the computer is a machine may facilitate the learning of those students with social-evaluative anxiety. That is, there are some students who are apprehensive about being evaluated by other persons (instructors or tutors), but would feel more relaxed with the computer and hence, learn and perform better.

Faculty members at other colleges and universities who have used CAI instruction in their courses also report with near unanimity the enhancement of student learning and performance. In addition, student acceptance of CBE appears to be remarkably good. In some courses, student endorsement runs as high as 95 percent. The most conservative estimate is that at least 50 percent of all students who have had contact with CBE instruction give positive appraisals of the system. The interesting feature of this evaluation is that the student assessment is not only favorable, but highly enthusiastic. This point perhaps should be emphasized in any evaluation of CAI instruction, i.e., if students enjoy learning via the computer, they may be sufficiently motivated to learn well and hence, achieve at higher levels.

As mentioned earlier, it is evident that CAI is only as good as the courseware that is available for its use, and that the construction of sophisticated courseware requires a large investment of faculty time and effort. In the interest of engaging in productive, cost-effective uses of CAI, it is imperative, therefore, that emphasis be placed on the concept of utilizing existing courseware wherever possible. Internal courseware development should be approached on a limited, carefully reasoned basis.

5.2.4 University of Hawaii Experiences

Since Summer 1977, a "pilot project" at the University has been attempting to determine the need for and value of an extensive CAI system. Our existing computer resources are being used to provide some CAI services for lessons written in the BASIC, APL, PILOT, or ATS languages. Although the existing facilities are capable of processing these languages, resources are already saturated, so that it is impossible to provide operational CAI even to small segments of the University without additional equipment. The existing facilities do not and cannot handle the more elaborate PLATO system. Thus, the bulk of the pilot project budget has been used to lease communications lines to the mainland and to pay for PLATO services provided to us by the University of Illinois. For the University to continue present PLATO services, we must either continue to lease telephone (or satellite) communications to the mainland and purchase PLATO services from a mainland vendor; acquire a Control Data PLATO system; or possibly buy PLATO subscription services through Control Data f.o.b. Hawaii if that service is made available.

Several reports will be prepared by the systemwide CBE Committee, the sponsors of the pilot project. Some of the information to be included in these reports will be: results of questionnaires sent to faculty; reports of site visitation trips by faculty to mainland institutions; evaluations of student achievement in courses where CAI has been used by all students; comparative evaluation of student achievement in courses where some students used CAI and others did not; attitudinal surveys of students who have used CAI in class; mini-reports on hardware, software, support services, external evaluations and alternative sources of funding; and various other reports and documents discovered/generated over the period of the project.

Since the pilot project is still in progress and the final reports are being prepared, we will not try to summarize the data from the project at this time. It is sufficient to point out that the experiences to date at the University of Hawaii have been similar to those reported in other studies of CAI. Student achievement with CAI is as good or better than student achievement in traditional education in almost all cases, the time required for learning seems to be less, student and instructor attitudes are highly positive, and interest is widespread throughout the University. Moreover, we have had considerable success authoring instructional lessons in some fields, particularily in Japanese. Controlled studies are currently in progress and the results of these should be available in the near future. Those interested in the CAI experiences at the University are urged to consult these reports when they are issued.

5.2.5 A Viable CAI System

We believe that the relevant question about CAI is not whether it will find widespread (or even universal) use in higher education, but rather when and in what form. Is this the right time to get involved extensively? If it is believed that a viable system exists right now, then a decision to become involved should not be delayed. A "viable" CAI system is one which:

1) has a proven record of effectiveness in lessons/courses relevant to the University of Hawaii.

2) has gone through a development process, over a period of years, such that the software which controls the computer and the delivery of courseware is relatively error free and reliable.

3) has a substantial library of high quality existing courseware or lesson material in a variety of subjects, such that it is feasible for instructors to begin to make use of the system almost immediately.

4) supports many instructional strategies, such as simulation, testing, drill and practice, gaming, and tutorial instruction.

5) has an authoring language available that makes it possible to engage in sophisticated instructional programming, but yet can be utilized -- at least in its rudimentary forms -- by non-professional programmers.

6) provides the means for incorporating a multi-media approach to lesson design, one which allows the use of audio and visual aids, controlled by the system.

7) contains a record-keeping system to supply student performance data for instructors, and to support educational research in learning behavior.

8) is receiving widespread use, such that the potential increase in (sharable) courseware offers definite promise for the future.

It has been demonstrated that a CAI system, as described above, is available. The PLATO system, and only the PLATO system, meets these criteria presently. We believe that support of PLATO would result in sophisticated and extensive CAI capabilities available to the faculty of the UH system. We also believe that without PLATO, very limited use and development of CAI material would take place. The only remaining question is how valuable and effective CAI would be at UH on a large scale campus-wide basis. Five alternatives for the future have been considered in the order of increasing cost In the next section, we will attempt to forecast the consequences that might be expected for each of these possible paths.

5.3 ALTERNATIVE FUTURES

5.3.1 Abandon Formal CAI Efforts Within the University of Hawaii

In the judgment of the Committee, this alternative is neither practical nor academically responsible. The University must continue to provide improved time-sharing computing facilities. If time-sharing is available, those faculty who want to use the facilities for CAI will demand their use for this purpose and could not be prevented from making such use of the facilities. Any responsible academic institution must make available to faculty and students, within its means, the educational technology necessary to do the best job of teaching and learning. The computer, as an instructional tool, must be made available for CAI use.

This alternative would almost certainly lead to a recurrence and amplification of the problems faced at UH a few years ago: a lack of support for an endeavor in which many faculty members wish to be involved; a lack of coordination or organization for the CAI efforts that will occur in spite of an absence of institutional assistance; and a lack of advance in an area that can lead to an improved educational environment for the students of this University.

5.3.2 Abandon PLATO Efforts and Support CAI Using Non-PLATO Alternatives

The advantage of this alternative over the first alternative is that it allows faculty to continue use of available CAI systems and software. These systems provide easy authoring capabilities for drill-and-test and limited tutorial presentations.

On the other hand, use of CAI on general-purpose computers would, in many ways, be a waste of resources that were not designed for that specific kind of use. Students would be required to master system command languages, interact with the computer through terminals that were not designed for non-programmers, and compete for resources with all other users of the computer. Since our current computers are already totally saturated, future CAI uses would immediately require additional facilities. The authoring languages that would be available, while good for drill-and-test are very restrictive and limited in their other capabilities. Similarly, the modes of presentation and delivery that would be possible would be very limited, probably only allowing simple textual presentation. Further, the available library of applicable, quality courseware is quite small currently and will quite likely remain so for the foreseeable future.

At present there are no viable CAI alternatives to PLATO that could be implemented in the near future. To support CAI, but not PLATO, would assume that some other viable system will be developed either here or elsewhere. Even relying on the fifteen-plus years of experience that have gone into developing PLATO, it is unlikely that any viable system will be available within the next five or ten years. This second alternative, we believe, would lead to a low level of involvement in CAI at the University at the expense of faculty morale and the potential for educational improvement.

5.3.3 Continue Current Support for CAI Including Plato

This third alternative offers an advantage over previous alternatives by maintaining contact with the PLATO technology and continuing work in those areas where productive PLATO use has already begun. Although further small-scale evaluations of the system in the context of specific courses would be possible under this alternative, the results probably would not contribute any additional information of substance beyond what is already known about the sytem and its capabilities.

If, on the other hand, there is no commitment by the Administration to attempt to bring PLATO to the University now or in the near future, then this is the time to make that position clear and to terminate central support for PLATO services. The number of PLATO terminals provided by the current level of support is not adequate to demonstrate satisfactorily the system throughout U.H., much less use it very widely or productively. Costs per student contact hour are also relatively high at this level of usage, and so this cannot be viewed as a viable long-term activity.

Unless this alternative is selected solely as a temporary measure until greater support can be achieved, this choice would probably lead the University through a frustrating period of undersupported services, and ultimately, no closer to a decision or solution.

5.3.4 Upgrade PLATO Facilities to Productive Use at Selected Sites (32 PLATO Ports)

This alternative allows full-scale utilization of a viable CAI system (PLATO) on one or more campuses of the University. Not only could these campuses benefit from CAI availability, but it would also provide the University with an opportunity for potential future payoff. For example, the BASIC SKILLS Courseware and other curriculum materials now under development could be utilized as an alternative, highly promising, approach to the problem of remedial education and the teaching of the so-called transitional courses in the community colleges of the State. It also would permit (1) the continued development of a specialized courseware of special interest to the University--and the state in general--such as the Japanese language courseware under development by Professor James

Unger, and (2) the use of courseware that has already been tried and found to be desirable additions to the University curriculum.

It is intended that the commitment for 32 ports would be for a three-year period. This would provide significant CAI implementation throughout one or more campuses of the University for a reasonable period of time. If CAI is to be effective in improving post-secondary education in more than a few isolated disciplines, the kind of productive utilization that could begin with this level of commitment would be necessary.

5.3.5 Develop a Phased Implementation for PLATO Throughout the University (192 PLATO Ports)

Expected advantages of this alternative include widespread use of PLATO, increased interest and enthusiasm by the faculty stemming from the long-range University commitment to PLATO, and potential cost savings if a decision to provide PLATO will ultimately be made.

This alternative, however, carries significant risks since, aside from the Basic Skills Learning System, there are currently no hard data that demonstrate conclusively the actual value of campus-wide CAI to the University of Hawaii. Although the data collected by the CBE pilot project appears primarily positive, before making a commitment of this scale, it would seem prudent to apply PLATO in the areas in which it has a proven track record, on a scale which allows the most opportunity to benefit students campus-wide. If this alternative is adopted, we would expect considerable CAI activity to develop throughout the University, almost exclusively on PLATO.

5.4 COST OF UPGRADING

If the University chooses to become a serious developmental site for PLATO courseware, an appropriate staff, under the direction of an academic unit of the University, is absolutely essential. The staff should consist of a project director, a professional instructional designer, two CAI programmers plus qualified student help, and a quarter-time technician. In addition, several half-time student helpers to monitor terminal sites would be required.

On the other hand, if the University chooses to put the majority of the PLATO terminals to use in a productive effort in a few subject areas such as basic skills, Japanese language, chemistry, and/or health sciences, and give courseware development a lower priority in the short term, the staff needs could be reduced. Given the current financial condition of the University and the State, this second approach is a reasonable course of action to initiate the prototype system. (See Table 5.2)

If, as expected, Control Data Corporation makes available in Hawaii PLATO services f.o.b. Hawaii, and if the University can acquire PLATO terminals on an incremental basis, then the decision to acquire PLATO should be left to individual campuses as their needs dictate and as their priorities warrant. Such individual acquisitions should be coordinated through a University systemwide CBE office in order to ensure appropriate use of University resources and proper coordination of CBE activities. In this manner, computer-based education can grow incrementally within the University until such time as it achieves sufficient critical mass to warrant installation of our own central University of Hawaii CBE system. (See Table 5.3)

5.4.1 32-Port PLATO Service

Control Data Corporation has indicated in informal proposals that a 32-port PLATO subscription service would be available at a cost of $715/terminal/month, or $8,580 per year for each terminal. This price would allow use of all of CDC's published courseware, any courseware which either Delaware or Illinois would or could allow us to use, and sufficient computer workspace to allow for our own courseware development. The cost of implementing a full, 32-port PLATO developmental site over the next three years as shown in Table 5.1 totals $1.275 million.

Table 5.1

Cost Projection for 32-Port PLATO Service

Projected Operating Cost ($ Constant)	1979-80	1980-81	1981-82	3-Year Total
Equipment and Other One-time Expenses	$135,000	$ -0-	$ -0-	$ 135,000
Lease Charges (Hardware & Software)	275,000	275,000	275,000	825,000
Personnel	100,000	105,000	110,000	315,000
Total Cost	$510,000	$380,000	$385,000	$1,275,000
Unit Cost				
No. of Terminals	32	32	32	32
Cost per Terminal	$ 15,938	$ 11,875	$ 12,031	$ 39,844
Annual Use (hours per terminal)	3,500	3,500	3,500	10,500
Cost per Terminal/Hour	$ 4.55	$ 3.39	$ 3.44	$ 3.79

5.4.2 Mini PLATO Service

Another alternative, in terms of service, would be to subscribe to a "mini" PLATO subscription -- one which allowed access to a limited selection of lesson material. It could include the subject areas mentioned previously, including the Basic Skills Learning System. Control Data has indicated that such service would be available at a reduced price, possibly $6,500 per year per terminal (excluding costs of the terminals themselves and local communications). Given these figures and a reduced staff as mentioned before, the total cost over three years as shown in Table 5.2 would be reduced to between $473 thousand and $689 thousand depending on the size of the expansion. Under this model, individual colleges/campuses would have the option of choosing to fund, say, an 8-port site at their location. Thus, if the system proved worthwhile, as we feel it will, incremental expansion could occur as desired.

Table 5.2

Cost Projection for Modest Expansion "Mini"-PLATO

Projected Operating Cost ($ Constant)	1979-80		1980-81		1981-82	
	16 Ports	24 Ports	16 Ports	24 Ports	16 Ports	24 Ports
Equipment and Other One-time Expenses	$ 50,000	$ 95,000	$ -0-	$ -0-	$ -0-	$ -0-
Lease Charges (Hardware & Software)	104,000	156,000	104,000	156,000	104,000	156,000
Personnel	35,000	40,000	37,000	42,000	39,000	44,000
Total Cost	$189,000	$291,000	$141,000	$198,000	$143,000	$200,000
Unit Cost						
No. of Terminals	16	24	16	24	16	24
Cost per Terminal	$ 11,813	$ 12,125	$ 8,813	$ 8,250	$ 8,938	$ 8,333
Annual Use (hours per terminal)	3,500	3,500	3,500	3,500	3,500	3,500
Cost per Terminal/Hour	$ 3.38	$ 3.46	$ 2.52	$ 2.36	$ 2.55	$ 2.38

5.4.3 Minimal PLATO Service

If the University chooses to delay a decision on PLATO (basically Alternative 3), the cost of continuing the current PLATO activity is given in Table 5.3. As can be seen, maintenance of the existing level of utilization would cost less than an expanded "mini" system. Unless the University has decided against any future PLATO implementation, it may be unwise to reduce PLATO support substantially below its current level.

Table 5.3
Cost Projection for Minimal System (8 Ports)

Projected Operating Cost ($ Constant)	1979-80	1980-81	1981-82	3-Year Total
Equipment and Other One-Time Expenses	$ -0-	$ -0-	$ -0-	$ -0-
Lease Charges (Hardware & Software)	83,000	83,000	83,000	249,000
Personnel	22,000	22,000	22,000	66,000
Total Cost	$105,000	$105,000	$105,000	$315,000
Unit Cost				
No. of Terminals	8	8	8	8
Cost per Terminal	$ 13,125	$ 13,125	$ 13,125	$ 39,375
Annual Use (hours per terminal)	3,500	3,500	3,500	10,500
Cost per Terminal/Hour	$ 3.75	$ 3.75	$ 3.75	$ 3.75

5.4.4 Future Expansion

It should also be understood that if an expanded PLATO system proves successful and popular, there will most likely be pressure from faculty on all campuses to expand PLATO significantly. We believe such a system could easily reach 250-400 terminals throughout the University. It is therefore important that University Administration realizes the magnitude of the potential economic burden. Using Control Data Corporation figures (from the previously mentioned proposal); and assuming controlled growth over a period of four years from a prototype level of 32 PLATO ports to 192 PLATO ports in annual steps increasing to 64 ports, 96 ports, 128 ports and 192 ports; the costs of leasing the hardware and software would exceed one million dollars per year by the third year.

As is shown in Table 5.4, the cost per station comes down significantly as the system grows. Three times as many terminals in the fourth year cost only about 50 percent more than the first year effort. It should also be understood that the committee is not recommending that the University system purchase terminals for the various campuses, but rather that those who wish to expand PLATO pay for their share from their own budgets. The costs shown are probably on the high side as well, because the least economical method of acquiring this hardware for a five-year period would be by lease. An installment purchase from CDC would probably come out less over the five years, plus give the University outright ownership of the hardware at the end of the five-year period.

Table 5.4
Cost Projection for Expansion from
32 Port System to 192 Ports in Four Years

Projected Operating Cost ($ Constant)	1982-83	1983-84	1984-85	1985-86
Equipment and Other One-Time Expenses	$ 160,000	$ 160,000	$ 160,000	$ 256,000
Lease Charges (Hardware & Software)	490,000	510,000	705,000	720,000
Personnel	150,000	175,000	200,000	250,000
Total Cost	$ 800,000	$ 845,000	$1,065,000	$1,226,000
Unit Cost				
No. of Terminals	64	96	128	192
Cost per Terminal	$ 12,500	$ 8,802	$ 8,320	$ 6,385
Annual Use (hours per terminal)	3,500	3,500	3,500	3,500
Cost per Terminal/Hour	$ 3.57	$ 2.51	$ 2.38	$ 1.82

5.4.5 Alternative Funding Sources

The cost estimates for providing varying levels of PLATO services assumes that the University central budget will bear the full financial burden of implementation and operation. It should be noted, however, that there are various alternative and supplementary means of funding PLATO that would reduce the overall cost to the University. For example, it is very likely that PLATO services could be sold by the University to other educational users in Hawaii. Several groups have shown an interest in PLATO, the most promising being the DOE, private schools and colleges and the State Correctional Facility Administration. We understand that the University of Delaware has recovered almost the entire cost of a recent upgrade by selling services to the FAA and to various elementary schools. If the University so decides it could become the leader in a Statewide consortium of such users. As a beginning, the consortium could limit its scope to a few areas which are of particular interest and show a particular need in our State and in the Pacific Basin -- remedial education and East Asian languages, to name two.

A second source of potential support is through external funding such as an NSF-CAUSE grant. Some private foundations have also shown interest in PLATO and might be approached for support. If efforts toward outside support could be organized effectively, the monies received might go a long way toward paying the costs of the computer assisted instruction.

A future possible avenue for reducing the effective cost of a PLATO system might be to off-load some of the batch computational research work to idle hours on a University owned PLATO system. This might result in PLATO being unavailable for a few hours late at night, and could also produce long turnaround times for the batch jobs. These trade-offs might be worth investigating.

5.5 FUTURE COURSE FOR CAI

In spite of the financial costs involved in pursuing the development of CAI as an instructional medium, we share the following belief expressed by the U.S. Presidential Commission on Instructional Technology: "In the conviction that technology can make education more productive, individual, and powerful; make learning more immediate; give instruction more scientific base; and make access to education more equal, the commission concludes that the nation should increase its investment in instructional technology, thereby upgrading the quality of education and, ultimately, the quality of individuals' lives and of society generally."

The Committee recommends Alternative 4, upgrading the PLATO facilities to 32 ports, as the next step for the University of Hawaii. Although computer-assisted instruction is viewed as belonging in the realm of instructional technology rather than computer technology, it requires a level of resource commitment similar to the applications of computer technology. Given the potential of computer-assisted instruction for improving the quality of higher education in Hawaii, a moderate expansion of PLATO facilities as outlined in Alternative 4 appears to be the most beneficial direction at this time.

We believe that sufficient evidence exists of PLATO's potential success, and enough interest and enthusiasm have been generated at the University, to warrant an expanded, intensive project, covering a period of about three years. The purpose of the project would be to provide two or three campuses with enough PLATO terminals and support staff to allow full-scale productive use of the system. At the end of this period, a decision could then be made concerning expansion of the system to all campuses in a full-scale implementation.

There is little question of the actual and potential benefits of a PLATO CAI system. The results of a survey of 22 student/faculty members who made site visitations during the first year and a half of the CBE Pilot Project, showed that of 15 who responded, all favored this alternative. Eight stated that they strongly favor it. This was a diverse population of both experienced and inexperienced CAI users. The main concern expressed by nearly all was (and is) the cost. A large-scale PLATO system requires a major funding commitment from the University's limited budget. However, we believe that productive use of the system could possibly result in a more cost-effective approach to some of Hawaii's serious educational problems; for example, the remedial education dilemma.

On the other hand, the Committee recognizes that the University faces fiscal constraints in the coming biennium. Thus, in the event that sufficient funds are not available to support Alternative 4, the Committee recommends, at a minimum the establishment of a small Computer-Assisted Instruction Office as a part of Alternative 3. The Office should be funded centrally to maintain an ongoing effort in CAI, to keep University personnel current in CAI developments, and to provide a central resource and coordination effort. The CAI Office should be regarded as an instructional activity and assigned accordingly. The office would assist and coordinate individual campus procurement of PLATO services, provided incremental expansion is a viable alternative.

APPENDIX A

A BRIEF HISTORY OF THE UNIVERSITY OF HAWAII COMPUTING CENTER

Appendix A

A BRIEF HISTORY OF THE UNIVERSITY OF HAWAII COMPUTING CENTER

In January, 1958, a committee of researchers appointed by Dr. Robert W. Hiatt, then the Director of Research, submitted a proposal to the University's Administrative Council for the establishment of a computing laboratory. The Council accepted the proposal which was subsequently approved by the Board of Regents and funds were appropriated by the Territorial Legislature for a laboratory that would provide for computing needs of the research community. A half-time position, together with funds for rental of an IBM 610 electronic processor, were provided for the 1959-61 biennium. However, the IBM Corporation informed the University that a new IBM 650 computing system with far greater capabilities than the IBM 610 was available and would be more appropriate for servicing a larger group of researchers. With the attractive offer of a 60% educational discount, a proposal was forwarded to the National Science Foundation in September, 1959, requesting assistance in acquiring the IBM 650 system. The NSF responded with a grant of $50,000 and together with $9,000 of Territorial general funds, originally intended for the rental of the IBM 610, the University acquired and installed the IBM 650 system in April, 1960.

The "Statistical and Computing Center" was thus established as an independent research service unit reporting to the Director of Research, however, with faculty and physical associations of the Department of Mathematics. The reason for maintenance of independence were to insure: (1) fair allocation of attention to all departments and faculty members, and (2) future expansion in terms of the computing needs of the University as a whole rather than in terms of a particular department or segment. The initial staff included:

Acting Director: Dr. Christopher Gregory, Mathematics

Head, Design Section: Dr. Robert Riffenburgh, Mathematics

Head, Data Processing: Dr. Paul Comba, Mathematics

Head, Education and Reference: Dr. John B. Furgeson, Economics and Business

The Center was located on the ground floor of Keller Hall and operated the IBM 650 on an open shop first-come, first-served basis. The quarters included a machine room, a lecture room, a statistical laboratory equipped with electromechanical calculators, and several offices for the part-time staff. During the ensuing period, the body of users began to grow and by November, 1961 included 10-20 users from the Hawaii Institute of Geophysics, Hawaii Marine Laboratory, Hawaii Agricultural Experiment Station, Institute of Health Research, Social Sciences Research Institute, Economic Research Center, Bureau of Business Research, Land Study Bureau, U.S. Fish and Wildlife Services, Honolulu Biological Laboratory, Hawaii Sugar Planters Association, Pineapple Research Institute and the State Department of Education. The full-time enrollment of the University at that time was approximately 7,800 in addition to the 800 faculty members. Although the facilities were available for instructional uses, the Department of Meteorology up until Spring 1961 was the only department that had integrated computers in their instructional curriculum.

With the increased interest and use of computing, three full-time positions were established in 1962. Dr. Edwin Mookini, Associate Professor of Mathematics, was appointed Director of the Center and his staff included a systems analyst, a secretary and six part-time students who assisted in programming and operations.

By the end of 1962, the IBM 650 was rapidly reaching saturation and a plan was made to acquire a medium scale computer complex with financing through a combination of general funds, an NSF grant and income derived from contract research use. Facilities for the planned system would be located in the Hawaii Institute of Geophysics and staffing would be augmented to handle anticipated rapid increase in users and applications. At that time, the 8,500 student enrollment was expected to more than double by 1972 and the faculty would increase from 1,000 to 1,800 during the subsequent decade. Research activity was also rapidly increasing. To provide an adequate computing facility a two-stage program was initiated to substantially raise the capacity of the Computing Center.

In Spring, 1963, an 8K byte IBM 1401 system with four magnetic tapes was leased to allow staff and users alike to become tape oriented and ease the transition from the card oriented IBM 650 to more modern systems. The IBM 1401 system was initially located at the Keller Hall site but later moved to new quarters in the Institute of Geophysics when an NSF grant in aid and legislative appropriations enabled the purchase and installation of an IBM 7040-1401 complex in August, 1963.

Mr. Walter Yee served as Acting Director in June, 1963 when Dr. Mookini left the University to establish the State's data processing facilities. Dr. Robert Sparks was appointed as the

Director in September, 1963 and was replaced by Dr. Wesley Peterson in August, 1964. Dr. Peterson served as Acting Director on a half-time basis until December, 1971 when Mr. Walter Yee was appointed Director.

With the availability of the IBM 7040-1401 complex in 1963 a rapid growth took place in use of computers for research, instruction and administration and it was later necessary to replace the system with an IBM 360/50. The 360/50, installed in January, 1967, was used for a period of two years when it too became saturated due to ever increasing demands for computer service during a period of rapid increases in enrollment and research activity. An IBM 360/65 was installed in February, 1969 and served the University's needs for a period of five years and was replaced by the current IBM 370/158 system in December, 1974. The Hewlett-Packard HP 2000 timesharing computer was acquired in April, 1973.

The Center, initially established as a unit of the Office of the Director of Research, reported to the Vice-President for Academic Affairs from 1963 to 1971. With a change in Administration in 1971, the Center became a unit under the Vice President for Business when the VP for Academic Affairs felt that the new VP for Business who had joined the University from the Scientific Data Corporation (SDC), was more knowledgeable in the uses of computers.

A Policy Advisory Board established prior to the installation of the 650 provided policy advice to the Administration and assistance to the Center. The policy board, comprised of faculty users, the Director of Research, VP for Academic Affairs, VP for Business and other technical resource persons, enlisted the assistance of a Technical and Planning Advisory Committee (TAPAC) in early 1970 to advise and make recommendations of a technical nature to the policy committee. TAPAC was represented by segments of the user community from all campuses of the University system. In April, 1974, with consideration of the roles and relationships of the Director of the Computing Center and the two Advisory Committees, Dr. Matsuda, then the Vice President for Business, ordered a change in the nature and format of the Policy Advisory Committee and TAPAC from permanent study committees to ad hoc committees which would be formed as needed in solving particular problems or to consult on particular policy matters. At the same time, the Vice President confirmed: (1) the organizational placement of the Computing Center under his office and (2) the Center as a statewide system service organization with the Director of the Center as a member of his staff responsible for the operation of the Center. The Center has been responsible to insure the provision of computing service to all segments of the University and throughout its history has attempted to service all users with balanced and efficient utilization of resources.

Table A-1

UH COMPUTING CENTER OPERATING COST

Description	Fiscal Year					
	73-74	74-75	75-76	76-77	77-78	78-79 (Est.)
No. of Personnel	(24.0)	(24.0)	(30.0)	(30.0)	(30.0)	(30.0)
A Personal Services	446,604	498,272	561,474	637,179	651,093	688,616
B Other Current Exp.						
DP Equipment	672,571	766,450	906,839	1,049,488	938,615	1,031,164
Maintenance	49,203	50,777	49,228	51,972	132,017	140,427
DP Supplies	74,555	80,250	85,065	90,169	95,579	107,313
Telephone	18,279	20,304	27,343	27,537	23,524	24,000
Others	51,775	66,513	69,302	38,421	39,177	40,000
Subtotal "B"	866,383	984,294	1,137,777	1,257,587	1,228,912	1,342,904
C Equipment	7,272	10,000	55,560	35,000	41,500	40,500
TOTAL	1,320,257	1,492,566	1,754,811	1,929,766	1,921,505	2,072,020
Trust Fund	295,730	346,429	431,212	500,000	550,000	600,000
General Fund	1,024,527	1,146,137	1,323,599	1,429,766	1,371,505	1,472,020

Table A-2

UH COMPUTING CENTER STAFFING

	Fiscal Year					
Position Counts	73-74	74-75	75-76	76-77	77-78	78-79 (Est.)
UHCC	19.00	19.00	27.00	27.00	27.00	27.00
MSO	3.00	3.00	--	--	--	--
Pres. Advisory Council	2.00	2.00	3.00	3.00	3.00	3.00
	24.00	24.00	30.00	30.00	30.00	30.00
Advisory Council FUNDING APPROX. included in GF above	35,000	35,000	35,000	35,000	35,000	35,000

-- EIF expenditures are not included in above totals.

Table A-3

UH COMPUTING CENTER TRUST FUND

Description	73-74	74-75	75-76	76-77	77-78	78-79 (Est.)
Beginning Balance	233,434	310,241	354,007	437,162	520,981	420,981
Revenues--Current Year	372,537	390,195	514,367	583,819	450,000	600,000
Total Available Revenues	605,971	700,436	868,374	1,020,981	970,981	1,020,981
Less Expenditures	295,730	346,429	431,212	500,000	550,000	600,000
Ending Balance	310,241	354,007	437,162	520,981	420,981	420,981

Notes: Beginning cash balances are necessary for covering certain contract encumbrances of approximately $400,000 per year. (Contracts cannot be effected without cash on hand for the entire fiscal year.)

Table A-4

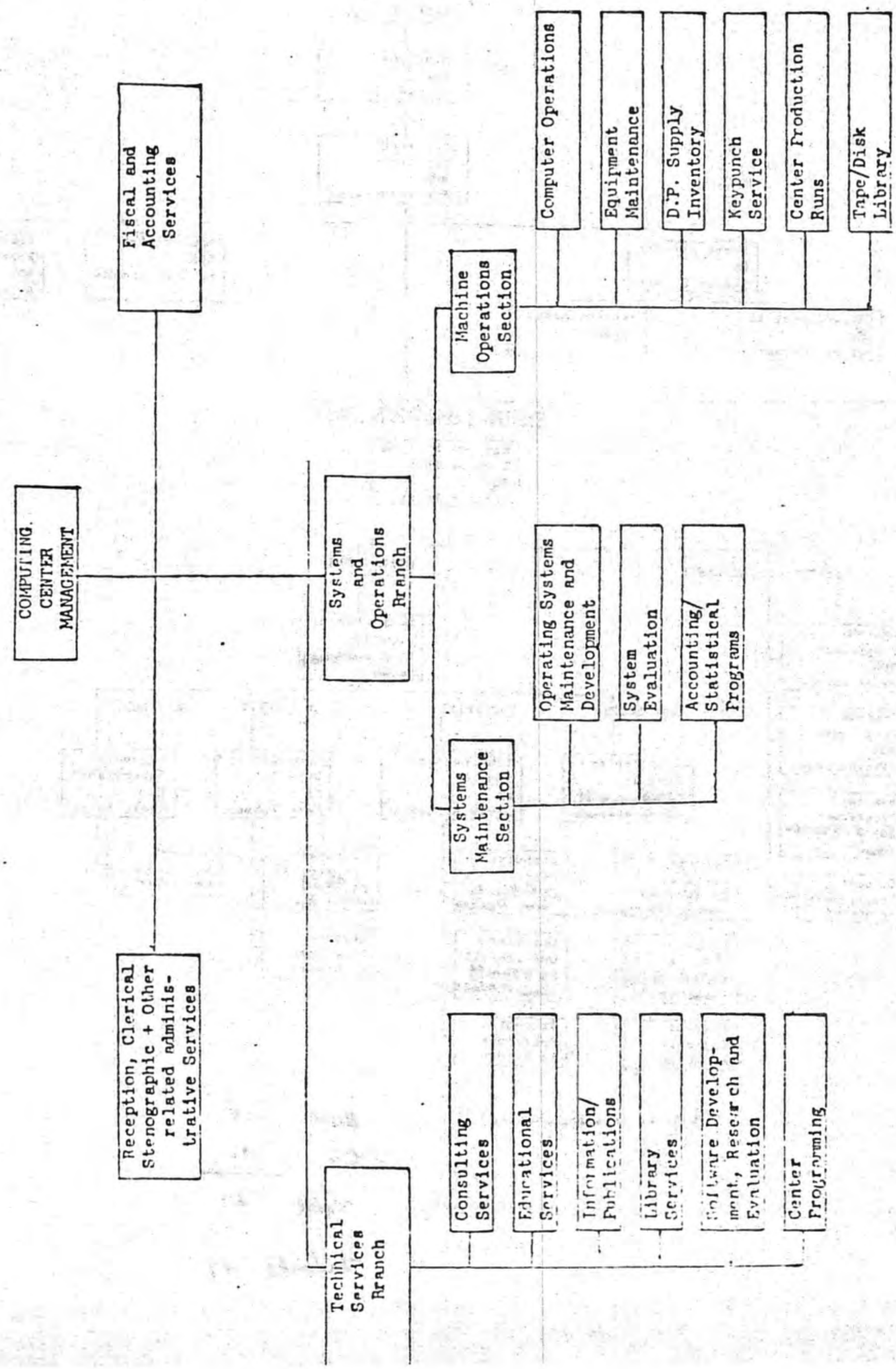
UH COMPUTING CENTER STAFFING AND OTHER HISTORICAL DATA

	1964-65	1968-69	1972-73	1976-77	1977-78	1978-7
Director	1.0	.5	1.0	1.0	1.0	1.0
Asst. Director	–	1.0	1.0	1.0	1.0	1.0
Fiscal Officer	–	–	1.0	1.0	1.0	1.0
Secretary	1.0	1.0	1.0	1.0	1.0	1.0
Typist-Receptionist	1.0	1.0	1.0	1.0	1.0	1.0
Supv. of Education	1.0	–	–	–	–	–
Supv. of Remote Operations	–	–	–	–	–	–
Supv. of Machine Operations	1.0	1.0	1.0	1.0	1.0	1.0
Mngr-Systems & Operations	–	–	–	1.0	1.0	1.0
Mngr-Technical Services	–	–	1.0	1.0	1.0	1.0
Supv. of User Services	1.0	1.0	1.0	1.0	1.0	1.0
Systems Programmer	2.0	4.0	2.0	3.0	3.0	3.0
Computer Spec/Consultant	3.0	4.0	5.0	6.0	6.0	6.0
Shift Supervisor	1.0	2.0	1.0	3.0	3.0	3.0
Operator	–	–	1.0	6.0	6.0	6.0
Key Punch Supv.	–	–	1.0	1.0	1.0	1.0
Adm. DP Prod. Coord.	2.0	1.0	2.0	–	–	–
Adm. Sysms Coord.	–	–	1.0	–	–	–
Total	14.0	17.5	22.0	27.0	27.0	27.0
Distribution of Function						
Director's Office	3.0	3.5	5.0	5.0	5.0	5.0
User/Technical Service	5.0	5.0	6.0	7.0	7.0	7.0
Operations	2.0	3.0	5.5	11.5	11.5	11.5
Systems Programming	2.0	4.0	2.5	3.5	3.5	3.5
Adm. DP Support	2.0	2.0	3.0	–	–	–
Student Help (Total Bodies)						
Clerical	–	2.0	2.0	3.0	3.0	3.0
Key Punchers	10.0	10.0	8.0	10.0	10.0	10.0
Programmers	2.0	2.0	5.0	7.0	7.0	7.0
Operators	16.0	32.0	36.0	27.0	27.0	27.0
Total	28	46	51	47	47	47
Full Time Equiv. (3 to 1)	9.3	15.3	17.0	15.7	15.7	15.7
COMPUTER SYSTEMS						
No. of Users	300	1,200	3,200	9,000	10,000	12,00
Jobs Processed (x 10^3)	–	–	–	746	858	99
Time Share Connect Hours (x 10^3)	–	–	–	112	150	20

UNIVERSITY OF HAWAII

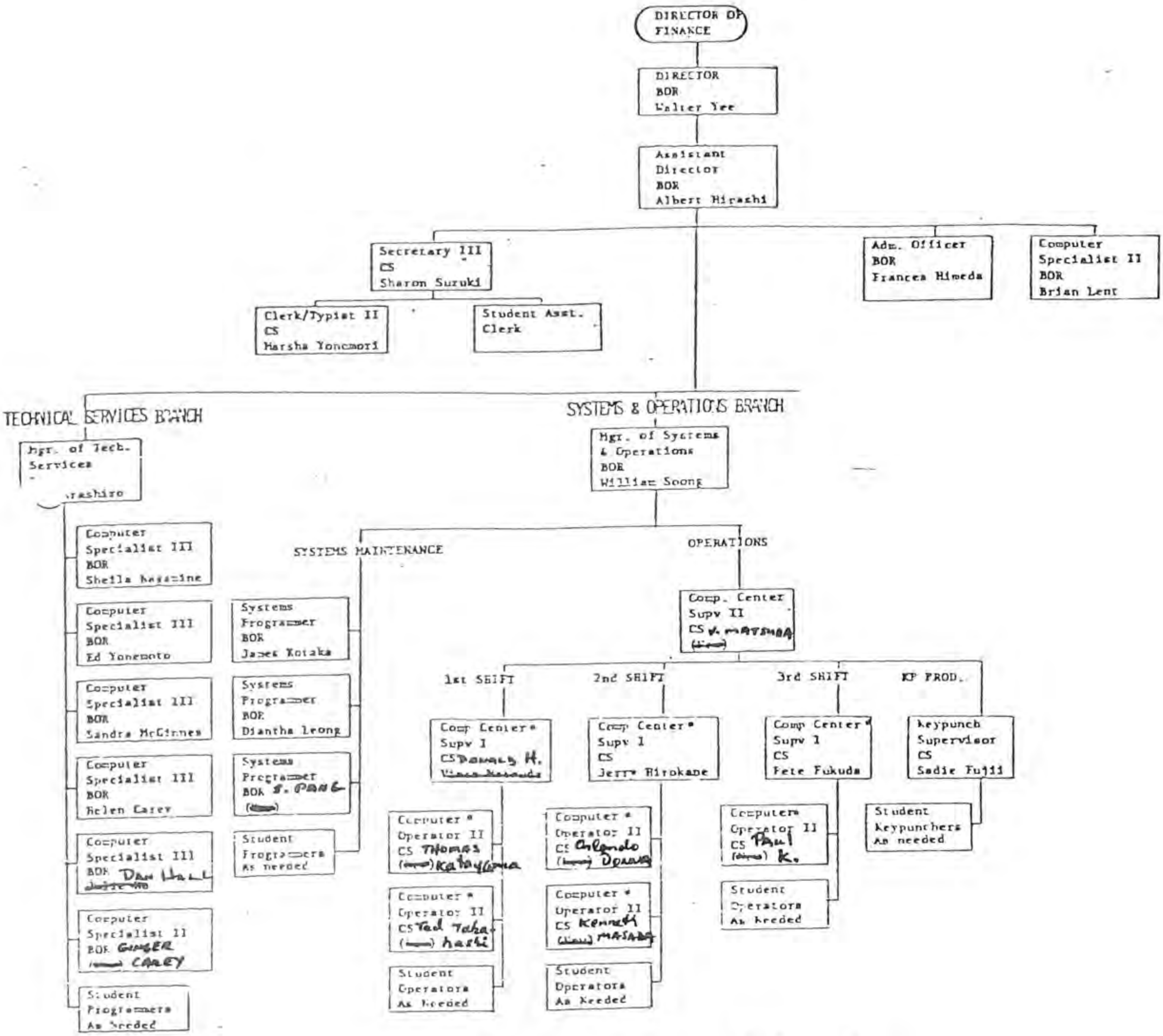
COMPUTING CENTER

Functional Organizational Chart



~~APR 18, 78~~
[redacted]
JAN 1, 1979

COMPUTING CENTER
POSITION ORGANIZATION CHART



*Will be rotating shifts.

BOR	15
CS	12
Total	27
Students	47

APPENDIX B

EXAMPLES OF PROBLEMS ARISING FROM INADEQUATE COMPUTING SERVICES TO THE ACADEMIC PROGRAMS

Appendix B

EXAMPLES OF PROBLEMS ARISING FROM INADEQUATE COMPUTING SERVICES TO THE ACADEMIC PROGRAMS

The purpose of this Appendix is to document, in abbreviated form, user complaints and examples of problems noted by faculty and staff. User complaints and criticism further emphasize the Committee's finding that the present state of computing services at the University of Hawaii is inadequate to meet the computing needs of the University's academic users. Academic users are the UH faculty, staff, and students involved in instructional, research, or training use of the computing services offered presently by UHCC.

The most strongly worded and persistent complaints concern the inadequacy of the timesharing use of the IBM 370/158 system via remote terminals. There are at present about 300 remote terminals, tied into 40 computer ports, which are used by many (if not most) of the regular users of computing services to initiate jobs, to modify programs already on computer disc file, or to compose or edit texts. These terminals are conveniently located in offices and laboratories across the various campuses. The principal difficulty experienced by the users and noted in their comments is the long waiting time to get access to the computer. Access to the computer through remote terminals becomes intolerably long at peak-load times; e.g., during the middle of the working day. Despite the establishment of priority systems for sequencing users, short-term, "bandaid" hardware improvements, and various attempts to encourage more off-peak use, the saturation of the University's timesharing system has become steadily worse.

Users' complaints and appeals for a new timesharing computer date back long before Spring 1978, but the formation of ACAC and the desire for a Long-Range Plan have delayed implementation. Examples of appeals for better timesharing are given later in this appendix.

Batch computation of jobs submitted directly to the Computing Center also has experienced complaints, usually about slow turn-around time during the working day. This is related in part to the widespread use of remote terminals for timesharing and the priority given to shorter jobs during the day. Many batch jobs are longer and are run overnight when there is less demand from remote-job-entry terminals. A satisfactory solution for timesharing will most likely also improve batch computing turnaround.

The complaints of academic users concerned with computer-assisted-instruction (CAI) are included under timesharing, since most CAI at present makes use of remote terminals. However, the larger issue of computer-based-education (CBE), especially using the full potential of the PLATO system, is a major topic treated elsewhere in this report. Since CBE is still in the experimental stage at the University of Hawaii, there are not yet the large number of outraged users who feel "deprived" of good CBE facilities or compare UH Computing Center services unfavorably with CBE facilities elsewhere. However, the specialists involved with CBE have expressed their dissatisfaction with response time and access, and the impact of delays on their ability to use the computer as an instructional device.

The remainder of this Appendix consists of specific examples of user suggestions and complaints received in one of three ways:

(1) spontaneously, as an expression of concern, alarm, or outrage, usually directed to staff of the UH Computer Center, or to the chairman of ACAC:

(2) in response to Users Surveys made periodically by the UHCC;

(3) in response to an ACAC announcement, published twice in the University Bulletin, requesting comments on computation needs.

In addition, the Ad-Hoc Committee on Computer Policy of the Manoa Faculty Senate Executive Committee, chaired by Mr. Patrick Gilbert, has summarized many of the concerns of the academic users in its report.

A. Examples of Comments/Complaints Re Timesharing: The overwhelming majority of responses received since early 1978 have been to protest the "unacceptable" delays in being able to "log-on" the system in order to use timesharing and the "waste of valuable time" in attempting to accomplish computing via timesharing.

A recent submission to ACAC states: "... the timesharing facilities here... (are) unsuitable for conducting research. The delays incurred in using TSO, the slow response, and unavailability of many solution packages through TSO are definite drawbacks. I have used a timesharing system at another university... and I estimate that it now takes me twice as long to complete half as much work."

Another researcher is also very critical of the present timesharing system: "My research is exclusively computer-based... and my uses of timesharing include manipulation of source data sets of batch jobs and interactive debugging of subroutines. Satisfactory progress of this research requires that I have access to timesharing service during holes in my teaching schedule, and it requires rapid response of the system. Neither of these criteria is met by the present system.... All ports were in use during 50% of my log-on attempts between 9 a.m. and 5 p.m. (during Spring 1978) and (during the Winter of 1978) about 15% of my log-on attempts failed because all ports were in use. I anticipate that the present system will be saturated... and thus useless to me... by Fall 1979." "Faculty time... is too valuable to be wasted staring at a mute computer terminal, yet that seems to be the current penalty for computer-based research at Manoa."

From the School of Medicine we hear that "...Because of the slow response time of our present system, it is difficult to get our students to do elective coursework on TSO. I can symphathize with them, because until we get faster response times, conventional study techniques are less frustrating. ...At the University of Texas... the computer center provided 10 terminals for our department, and the students logged hundreds of hours. The response time on their DEC system was instantaneous."

A Botany professor writes that "I was very disappointed to learn that a new timesharing system was deleted from the UH budget request in the Governor's office. I... hope that you can convince the central administration to get that item back into the budget as a very high priority item.... My major gripe about our timesharing system concerns my inability to meet deadlines... (due to poor response time and turnaround).... My apologies and excuses to federal agencies meet with little sympathy. They find it hard to believe that we have such a poor timesharing facility."

Computer Science students have also complained about the lack of timesharing facilities. One complaint pointed out that timesharing is a major aspect of the computing field and exposure to timesharing is essential to computer science education. To be adequately prepared and able to compete in the job market, UH students must have improved access to significantly more sophisticated timesharing computing capabilities than are presently provided. Hundres of ICS students currently have to try for as long as one or two hours to gain access to the computer on which they are required to complete weekly assignments. Students in Business, Engineering, and other disciplines experience similar delays and frustrations. One student compared our situation to that of a hypothetical chemistry course for which students have to knock on the door to the lab continually for an hour or two before being allowed to use the lab for required course work.

A few additional brief written comments directed to the Computer Center Director and Staff may add to the general image of frustrated users:

"...TSO is much too slow...Get another computer to handle only TSO!!"

"...we had a TSO terminal but gave it up. The TSO system was so slow and difficult to get on...."

"The Center desparately needs a high volume TSO computer...."

"Put the students who are just fooling around wtih TSO anyway on a lower priority and let serious users get their work done...."

"With a better timesharing system which will allow more users at a time and faster response most of the time, the UH computing community will not only be a more productive one but also a lot happier one."

There are a number of other separate letters to ACAC recently, in addition to 33 contributions to UHCC via the 1978 Users Survey and the Complaint/Suggestion Box. Some of these complaints are highly colorful: e.g., "...when it takes 1½ hours to get my 10 second job out of the queue, I'll take my business elsewhere!" A summary of these complaints/comments is on file at UHCC and ACAC.

The timesharing operation began to approach saturation early in 1978, as evidenced by complaints by users at that time. Specific letters of complaint were received from the East-West Center group, from High Energy Physics, Population Studies, the Dean's office (Arts and Sciences), Botany, Sociology, and many others.

During the Summer 1978 the installation of the Attached Processing Unit (APU), plus the reduction in student jobs during the summer, relieved the situation somewhat. However, by the Fall 1978 activity had increased to saturation. It is clear that the APU proved to be only a temporary help.

B. Batch Processing Examples: With most of the computer time during the daytime hours consumed with the demands of interactive computation, the number and complexity of "batch" jobs which can be run has been much reduced. Concern has been expressed that the solution to timesharing should not further degrade batch computation.

One regular user adds to his comments on timesharing that "...I also rely heavily on batch mode 'number crunching,' and any steps which degrade batch service are unacceptable."

The High Energy Physics Group, one of the major users of computer time on the Manoa campus, has been forced to request special Sunday runs (e.g., at 3 a.m.) of batch processing in order to meet research deadlines. Production runs can no longer be made during the day time; occasionally these are not even run overnight, due to saturation of facilities. In such cases, delays of up to a week can accrue, and completion of results which depend upon sequential runs can become critical. As a result of problems with both timesharing and batchprocessing delays, plus an equally important goal of achieving "on-line" data reduction from semi-automated film measuring devices, the High Energy Physics Group has taken steps to purchase its own dedicated Minicomputer (a VAX 11/780) during 1979.

C. Summary of Examples: It is very clear, from the examples cited above and referenced plus the surveys of user opinion, that something must be done during 1979 to relieve the saturation of computing facilities at the University of Hawaii. Irreparable harm will be done to the competitive position of UH faculty research and instructional activities that are dependent on using computing services if we allow further delay.

APPENDIX C

REPORT OF DR. JAMES A. BAKER

Appendix C

July 5, 1978

MEMORANDUM

To: Warren Gulko, Chairman
Academic Computer Advisory Committee

From: James A. Baker, Consultant JAB

Subject: Observations and Recommendations (Preliminary version)

During the interval from June 26-29, 1978, I interviewed a variety of users of the University of Hawaii Computer Center and the Computer Center Director. On June 29 I met with the Academic Computer Advisory Committee and gave them my impressions of the present state of the Center, together with some recommendations about possible future directions for the Center. This memorandum summarizes these observations and recommendations.

Computer-based Instruction

I agree, in general, with the comments made by Wayne Lichtenberger in the committee meeting about computer-based education.

The effective implementation and use of a computer-based education (CBE) system demands important commitments from both the administration and faculty of the University. These commitments include, but are not limited to, the following:

1. Willingness on the part of the faculty to devote a large effort to the evaluation of already existing course materials and to the preparation of new course material.

2. Recognition by the administration of the value of these activities and of the necessity of making appropriate reduction in teaching loads for faculty members engaged in them.

3. The implementation of an effective system for the evaluation of the CBE system.

All of these commitments must be made prior to the installation of any CBE system.

It is my feeling that one of the most fruitful areas for the application of CBE would be on the community college campuses for remedial work in mathematics and English.

Memo - Warren Gulko July 5, 1978

Present State of the Center

The management of the Computer Center seems to me to be doing an excellent job within the constraints of budget and policy imposed upon it. I think the scheme it devised for the purchase of a large segment of the present IBM 370/158 system was particularly creative. The acquisition of the Gandalf switch was an excellent management decision. Staff size and balance seem appropriate.

The following criticisms of the present operation of the Center were made:

1. No mechanism is available to the research user of the computer who wishes to obtain faster turnaround time for reasonably large jobs. It was suggested that a higher priority should be available to such jobs at a greater than standard cost.

2. Communication between consultants and systems programmers seems to be inadequate. I feel that this is an important criticism since this line of communication is almost the only channel between users and systems programmers.

3. Some users remarked that methods and materials to introduce the naive user to the system were inadequate.

Because of the present saturated state of the computer, batch turnaround time is unacceptable. Moreover, response time for both interactive systems currently used on the 158 is excessive.

The number of ports (48) provided for interactive connection to the 158 is inadequate to meet the current demand for interactive service. This problem has been somewhat alleviated by the installation of the Gandalf switch.

Interactive service provided by the Hewlett-Packard machine is very satisfactory. Applicability of this service is, however, somewhat restricted since only the BASIC language is offered.

Service provided by the DEC PDP-11/70 computer installed at Leeward Community College is very satisfactory. However, additional terminals are required at that site.

At Kapiolani Community College, the IBM System 3 computer provides adequate service for students enrolled in the data processing program. However, this machine is not adequate to provide service for students enrolled in other programs.

Recent Technological Developments

Certain recent technological developments in computing have important implications for the design of computer service facilities in academic environments.

Until a year or two ago, important economies of scale could be achieved through the centralization of computer service facilities. Economies could be achieved both in capital equipment cost and in operation cost. It was cheaper to do almost any problem on a large computer than on a small computer. Operating systems and language processors were error-prone and tended to be unstable. Systems programming costs could be minimized by supporting only a single large system.

In the past year mini-computer hardware has been introduced which is cost-effective against even the largest available mainframes. Mini-computers are now available whose power is very close to the power of the IBM 158 machine. The cost of these machines is only a fraction of the cost of the 158. Similar trends are observed in the cost of peripheral devices for small machines.

Operating systems and language processors for mini-computers have become cleaner in design, more error-free, and more stable. An interesting example is the Hewlett-Packard computer currently installed in the Computer Center; it ran for over a year with zero hardware or software failures. The cost of operating such a system is obviously small.

Recommendations

The following list of recommendations is not comprehensive. I shall supply a more detailed list within the next week or two.

1. The Academic Computer Advisory Committee should be chartered on a permanent basis. Committee members should represent all important segments of the computer user community. Appointments to the Committee could be for a term of two or three years. The appointments should be staggered. The Committee should advise the Director of Finance about current Computer Center problems and make recommendations to him concerning future directions for computing at the University. The Director of the Computer Center should be an ex-officio member, but not the Chairman, of the Committee. The current charter of the Committee to develop a long-range plan for computing should be continued.

2. The tasks of developing a long-range plan for the Computer Center and developing a long-range plan for computer-based education should be separated. Although the ACAC may be responsible for both of these tasks, I feel that the timetable for the development of the plan for the Computer Center should be much shorter than the timetable for the development of the plan for CBE.

3. Walter Yee's plan for the installation of one or more mini-computers at the Manoa campus should be accepted. Careful consideration should be given to the selection of this machine.

In addition to the DEC System 20, the DEC PDP-11 family, the Prime, the Data General, and the Harris machines should also be studied.

4. The long-range plan should include the installation at all community colleges of machines compatible with the interactive system installed at the Manoa campus.

5. It is agreed that the IBM system should gradually be phased out of general purpose use and, ultimately, should be devoted exclusively to administrative applications. Careful consideration should be given to the replacement of the 158 by an IBM plug-compatible mainframe.

6. Consideration should be given to the replacement of some leased peripherals by plug-compatible peripherals.

Final Note

This report is to be regarded as preliminary. I will transmit a final report to you within the next week or two.

cc: Members of the ACAC
Walter Yee

Further Remarks and Recommendations on the Computer Planning Process at the University of Hawaii

James A. Baker

INTRODUCTION

During the week of June 26, 1978, I visited the University of Hawaii. During this visit I interviewed the Director of the Computer Center, various computer users, and certain members of the University's administration. On June 29 I met with the Academic Computer Advisory Committee and gave them an oral summary of my findings. I submitted a preliminary written report, dated June 30, to Dr. Warren Gulko, Chairman of the ACAC.

This document is a supplement to the interim report. It expands upon some of the issues covered in the original report, discusses the computer planning process, and makes some additional recommendations.

DEMAND FORECASTING

Forecasting of demand for computer services is basic to any successful computer planning exercise. However, demand forecasting in an academic environment presents certain special problems.

Administrative applications and supported research applications represent fairly easy problems. Demands in the administrative area result from the planned implementation of applications. Generally speaking, after an application has been implemented it runs on a cyclic and predictable schedule. Administrative user departments should be able to predict their demands quite accurately two or three years in advance. Computing demands originating from supported research projects can be forecast by requiring that each proposal submitted to a sponsoring agency explicitly detail the portion of the requested funds that will be spent on computing. Each proposer should also supply an estimate of the probability of success of his proposal.

Demands resulting from the use of computers for instruction and for subsidized research are quite another problem. It is footless to speak of "unmet demands" in these areas; the level of service in these areas should be determined by University policy. Decisions must be made about the proportion of the undergraduate population which will be required to take service computing courses: should these courses be required of engineering majors? physical sciences majors? business administration majors? all undergraduates? Moreover, decisions must be made about the level of support for computer applications to unsubsidized research projects. Are the University and the legislature willing to support extensive searches for ever larger Mersenne primes? Is the production of a concordance for the journals of Captain Cook worthwhile? It is not suggested that the University administration should decide these questions in detail. It is suggested, however, that the University administration must decide the level at which the computing requirements of unsubsidized research are to be supported.

I believe that an important function for the ACAC would be to provide advice to the University administration on appropriate support levels for these classes of applications.

In connection with demand forecasting, I would like to remark again that one should not distinguish between demands for batch processing and for interactive processing. These two classes of processing are drawn from identical demand for computer service. In the bright world of the future, when additional interactive facilities become available, almost all work will be submitted interactively.

Most of the responsibility for demand forecasting should rest with the management of the computer center. Their projections should, however, be reviewed annually by the ACAC.

PLANNING AND TECHNOLOGY DEVELOPMENT

The tricky feature of computer planning is that one must plan to meet the demand for computer services three years hence with technology that will be available three years hence--not with technology that's available today. In addition, one must plan current acquisitions so that they are not too badly obsoleted by products that will become available in two or three years.

Some recent and anticipated technological developments which should be of concern in planning the University of Hawaii's computer acquisitions are:

1. The recent announcement by Digital Equipment Corporation of the VAX-11/780 computer. Benchmark testing of this machine reveals that it is price competitive with any computer on the market with the possible exception of the CRAY 1. It is anticipated that other minicomputer manufacturers, including Data General, Modcomp, Prime, SEL, and Hewlett-Packard, will announce machines competitive with the VAX in the next year or two.

2. Three companies (National Semiconductor, Magnuson, and TwoPi) have recently announced IBM plug-compatible mainframes which lie in the same price range as the VAX machine. These machines are competitive with the IBM 370/138 and 148.

3. IBM plug-compatible peripherals and memories are becoming increasingly competitive.

4. Very high speed local communications networks are now commercially available. (For example, from Network Systems, Inc.)

Some general trends in the computer industry are interesting to the planner:

1. Grosch's Law has been repealed; it is no longer cost effective to buy the biggest possible mainframe.

2. The cost of central processors and memories will continue to decline for the next few years.

3. Systems programming has finally reached its adolescence. The lead time and cost of producing new operating systems and language processors have both decreased. New systems software products are much more stable and reliable than has been the case historically.

The task of designing an optimal computer configuration to support a given workload is relatively simple. However, life is not that beautiful. The planner must provide for an orderly transition between the old system and the new one. Conversion problems should be minimized; popular applications packages must either be transported to the new system or preserved on the old one; the problem of transportability of files must be faced.

THE PROLIFERATION PROBLEM

The problem of the proliferation of independent computer centers arises almost continuously in academic environments. The availability of powerful but relatively inexpensive minicomputer systems will tend to exacerbate this problem.

The director of an independent research unit or the chairman of a department can make quite rational arguments for the acquisition of his own computer system--especially if the system is to be extramurally funded. I believe such an acquisition is justified if the system is to be dedicated to a single application or is to be used as a control or data taking element in a larger system. However, I do not believe that such acquisitions should be justified by the argument that the user is currently receiving inadequate service from the computer center.

I believe that general purpose computation facilities within the University system should be administered by the computer center.

RECOMMENDATIONS

The recommendations listed below are designed to supplement or to reinforce the recommendations in my original report.

1. A plan for hardware acquisition by the computer center should be devised which attacks the immediate problem of inadequate interactive service. At the same time, the plan should be designed to permit the gradual migration of a majority of the instructional and research load of the computer center away from the 158. The plan should contemplate the acquisition of a sequence of mainframes of the same family. It should be recognized that the general workload of the center will become more interactive as time passes--with the possible exception of certain administrative applications.

2. It would be desirable to provide the Hilo campus and each community college campus with a mainframe of the same class as those to be acquired by the Manoa campus. Systems programming support for the remote campuses should be provided by the computer center.

3. Provision should be made at the central campus for high speed file transmission between the new mainframes and the IBM computer. This file transmission system should permit the retrieval of data files from the IBM class computer, storage of data files on that machine, and the submission of batch jobs to that machine. Provision should be made for the disposal of output files from the interactive systems to printers or plotters on the IBM system. I believe that the current asynchronous system employing telephone lines is adequate for communications with the remote campuses. It should be recognized in the plan that the implementation of the proposed file transmission system involves not only a certain amount of hardware, but, perhaps, a substantial systems programming effort.

4. The ACAC should be charged with reviewing independent computer acquisitions by departments or research units. This review should be confined to systems with purchase price exceeding $100,000, say.

5. The RFP for the proposed interactive system should be written with the overall computer plan firmly in mind.

APPENDIX D

INVENTORY OF COMPUTERS IN THE UNIVERSITY OF HAWAII

Appendix D

INVENTORY OF UH COMPUTERS
(as of January 15, 1979)

This inventory is listed by sub-categories of responsibility within four categories of primary usage. Responsibility sub-categories include ownership by UH System Administration, UH Manoa, UH Hilo and Community Colleges, while the four areas of primary usage are as follows:

General Purpose/Instruction	Includes computers primarily used for instructional support and/or other general computing needs of administration and research.
Special Purpose/Research	Computer systems used primarily for control of instruments, experiments, data acquisition, and other special purposes. Also included in this category are systems used primarily for research purposes by research organizations and projects.
Microprocessors	Microprocessor based systems used for any purpose.
Unused Systems	Systems originally acquired for research or other purposes but not in use.

Manufacturer abbreviations used are as follows:

ADTECH	Adtech Corporation - Honolulu
ALTAIR	Altair Corporation
APPLE	Apple Computer Incorporated
BCC	Berkeley Computer Corporation
CDC	Control Data Corporation
COMPUCOLOR	CompuColor Corporation of Georgia
CROMENCO	Cromenco Incorporated
DEC	Digital Equipment Corporation
DG	Data General Corporation
HARRIS	Harris Computer Corporation
HP	Hewlett-Packard Corporation
IBM	International Business Machines, Incorporated
IMSAI	IMSAI Manufacturing Corporation
INTEL	Intel Corporation
OSI	Ohio Scientific Corporation
SWITCH	Manufacturer unknown
TI	Texas Instruments Corporation
WANG	Wang Computer Systems
8080	Refers to microcomputers based upon the Intel Corporation 8080 microprocessor chip

CATEGORY I - GENERAL PURPOSES AND INSTRUCTION

A. UH System Administration

Manufacturer/ Model	Dept.	Primary Use	Contact	Remarks
1. DEC PDP 11/34	Mgmt Systems Office	Administrative data processing	Raleigh Awaya x8328	This system provides remote job entry to UHCC IBM 370/158 for administrative production and systems development. The system is also used as a controlle for a cluster of high speed video terminals used for management information entry and retrieval.
2. HP 2100 ACCESS	UH Comp Ctr (UHCC)	Instruction & research time-sharing	Walter Yee x7351	A single language (BASIC) system with 32 ports with service to all UH departments. Eight of the 32 ports are dedicated to School of Business and not directly accessible by others.
3. IBM 370/158 -AP	UHCC	General purpose batch processing, time sharing & teleprocessing	Walter Yee x7351	This sytem is available for use by anyone in UH system for administration, instruction and research. Services include remote job entry and on site batch processing and general time sharing with a diverse complement of languages and software. Forty (40) ports of Time Share Option (TSO) and 10 ports of APL are available. Limited use of time sharing for administrative data processing. However, a management information teleprocessing system (CICS-ADABAS) is implemented.

B. UH Manoa

4.	BCC 500	Elect. Engr.	General purpose instruction and research time sharing	Wayne Lichten-berger x7589	Service to EE courses and some research users. 24 time sharing ports are available. This one of a kind system is operated and staffed by one person and was originally acquired for research purposes by the ALOHA project.
5.	HP 2114	Elect. Engr. Lab	Instruction	Wayne Lichten-berger x7589	This stand alone system is ocassionally used by graduate students and is not normally used in conjunction with formal courses.
6.	HP 9600	Elect. Engr.	Instruction	Thomas Roelofs x7218	A course in engineering filter design is taught through the use of this special system.
7.	PDP 11/03	Physics	Instruction	Walter Steiger x7087	This system will be acquired during the third quarter, FY 78-79 for use by graduate students in physics for experiment control and minor calculations.
8.	IBM 1130	Public Health	General purpose instruction and research	Chin S. Chung x8577	This is a remote job entry station to the UHCC IBM 370/158 (originally acquired by NIH funds for research use). Current uses include testing and monitoring of student progress in addition to general batch RJE.
9.	Wang 2200	Public Health	Computer assisted instruction	Robert Worth x8601	This system is used by instructors and students from the Schools of Public Health and Medicine for CAI work in anatomy, public health, bio-statistics and epidemiology. 8000-10000 quizzes are taken per year by systems 9, 10 and 11 combined.

10.	Wang 2200	Public Health	Computer assisted instruction	Robert Worth x8601	This system is used by instructors and students from the Schools of Public Health and Medicine for CAI work in anatomy, public health, biostatistics and epidemiology. 8000-10000 quizzes are taken per year by systems 9, 10 and 11 combined.
11.	Wang 2200	School of Medine	computer assisted instruction	Robert Worth x8601	This system is used by instructors and students from the School of Public Health and Medicine for CAI work in anatomy, public health, biostatistics and epidemiology. 8000-10000 quizzes are taken per year by systems 9, 10 and 11 combined.
12.	Wang 2200	School of Medicine, Dept of OB/ Gynecology	Computer assisted instruction	Ralph Hale x7457	Used by students taking courses in OB/Gynecology topics.
UH Hilo					
13.	DEC PDP8A	Hawaii CC	Computer assisted instruction	Kah Hie Lau 961-9320	There are two built-in terminals on this desk model "CLASSICS" system which is used for CAI remedial courses in various disciplines.
14.	DEC PDP 11/10	UH Hilo (Located at Hawaii CC)	General purpose instruction and research support	Kah Hie Lau 961-9320	Serves as a remote job entry station to UHCC IBM 370/158. No administrative data processing.
15.	DEC PDP 11/34	UH Hilo Psychology Discipline	Instruction	R. Lee Howard 961-9397	In addition to teaching, this system is also used for control of experiments, monitoring progress and data acquisition.

16.	DEC PDP 11/20	Hilo College Cloud Physics Lab	Data acquisition	David Raymond 961-9444	Used for analysis and recording of meteorological data generated from on-line instrumentation.

Community Colleges

17.	DEC PDP 11/34	Honolulu CC	Instructional time sharing	Reginald Wood 845-9252	Used for computer assisted instruction and testing of students. Eight (8) ports are available.
18.	DEC PDP 11/70	Leeward CC	General purpose time sharing	Robert Holz 455-0271	This system has 24 time sharing ports for computer assisted instruction, support of students in the computer science program, training of students for the computer industry, research and some administrative support. The system is also used as a remote job entry to the UHCC IBM 370/158.
19.	IBM SYSTEM 3-10	Kapiolani CC	Vocational education of students for computer industry	Robert Peppin 531-4654 (x133)	The system is also used as a remote job entry to the UHCC IBM 370/158, general administration and teaching.

CATEGORY II - RESEARCH AND SPECIAL PURPOSE SYSTEMS

A. UH System Administration

NONE

B. UH Manoa

Manufacturer/ Model	Dept.	Primary Use	Contact	Remarks
20. DEC LSI 11	Institute of Astronomy Mauna Kea Obsv.	Instrument control	James Harwood x8637	Controls operation of 88" telescope. This system replaced an older IBM 1800 computer system in 1978.
21. DEC LSI 11	Institute of Astronomy Mauna Kea Obsv.	Data acquisition	James Harwood x8637	Data acquisition in conjunction with 88" telescope.
22. DEC LSI 11	Institute of Astronomy Mauna Kea Obsv.	Instrument control	James Harwood x8637	Controls operation of 120" telescope.
23. DEC LSI 11	Instute of Astronomy Manoa	Programs development	James Harwood x8637	Programming systems development for observations.
24. DEC LSI 11	Institute of Astronomy Manoa	Instrument testing	Jeff Bosel x6664	Testing of scientific apparatus at infrared laboratory.
25. DEC PDP 8E	Physics and Astronomy	Data acquisition	Peter Crooker x7387	Built in as part of research interferometer.
26. DEC PDP 8I	Institute of Astronomy Haleakala Mees Obsv.	Instrument control, data acquisition	Jim Lieberman 1-244-5565	System is used for projects in solar research.
27. DEC PDP 8S	Biochemistry & Biophysics	Instrument control, data acquisition	R. McKaye x7862	This system controls high temperature chemistry research instruments.

28.	DEC PDP 11/40	Institute of Astronomy	Data acquisition	Richard Wolff x8379	Data obtained from a microphometer at the spectroplate measuring laboratory. Also analyzed on the system.
29.	DEC PDP 11/45	Institute of Astronomy	Data reduction	James Harwood x8637	This system is currently at Manoa, but will be shipped to Mauna Kea 120" telescope observatory for use in instrument control and data acquisition.
30.	DEC PDP 11/45	Institute of Astronomy	Instrument control, data acquisition	Jim Lieberman 1-244-5565	Used as part of the SKY Lab project for control and acquisition of data from a scanning coronal spectrograph.
31.	DEC PDP 11/45	Chemistry	Instrument control, data acquisition	Wendy Harrison x7379	This system has 16 time sharing ports used by various projects such as control of crystallography measurements. Some general time share services are also performed.
32.	DG NOVA 210	Institute of Astronomy	Back-up spare	Dennis Wong 1-244-9108	This is a back-up system for systems used at the Lunar Ranging Observatory on Maui.
33.	DG NOVA 800	Chemistry	Instrument control, data acquisition	Karl Seff x7665	Built in system which controls the operation of an X-ray diffractometer.
34.	DG NOVA 800	High Energy Physics	Instrument control, data acquisition	Dennis Wong 1-244-9108	Controls operation and data acquisition from "SWEEPNICK" instruments used for tracking of particle paths.
35.	DG NOVA 800	" "	"	"	" " " " "
36.	DG NOVA 800	" "	"	"	" " " " "
37.	DG NOVA 800	Institute of Geophysics	Program development and data reduction	Paul Jubinski x6650	This system duplicates software used on the shipboard NOVA 1200 (#41) below and is used at Manoa to provide data reduction, program development and maintenance for the shipboard system.

38.	DG NOVA 1200	High Energy Physics	Software development and data acquisition	Harry Yee x7998	Software is used on NOVA 800s. Data from 800s are reduced on this system.
39.	DG NOVA L200	Institute of Astronomy Lunar Ranging Obsv (Maui)	Instrument control, data acquisition	James Harwood x8637	Controls lunar ranging experiments.
40.	DG NOVA 1200	Institute of Geophysics (Kane Keoki)	Shipboard data acquisition	Paul Jubinski x6650	This datalogger logs ship and experiment data.
41.	DG NOVA 1200	Institute of Geophysics (Kane Keoki)	General purpose and shipboard data reduction	"	This system is the Kane Keoki's general purpose computer which is also used for reduction of data from datalogger.
42.	DG NOVA 1200	Institute of Geophysics (Kane Keoki)	Shipboard spare	"	On board back-up for ship systems.
43.	DG SUPER NOVA	Institute of Astronomy Lunar Ranging Obsv. (Maui)	Instrument control, data acquisition	James Harwood x8637	Used in lunar ranging instrumentation control.
44.	Harris S125	Population Genetics	General purpose research only system	Newton Morton x7186	This is a general purpose, 6 port time sharing system, funded by NIH for exclusive use of researcher in Genetic Epidemiology. This system was purchased (1/79) and replaced an obsolete CDC 3100 computer system.
45.	Harris S135	Institute of Geophysics	General purpose research only computer	Noel Thompson x6820	This system is a general purpose 16 port time share system used by various research projects in HIG. This system was recently (1/79) obtained as an upgrade of the Harris S125 which went to the Genetics Laboratory.

46.	HP 2100	Mechanical Engineering	Fourier analyzer	John Burgess x7544	Built in as part of signal processing system. Digital replacement for an analog spectrum analyzer Primarily research with occasional instructional use.
47.	HP 2100	Chemistry	Instrument control	C. Fadley x7780	Data acquisition from a Photoelectron spectroscophy is performed.
48.	HP 2100	Institute of Geophysics	Shipboard navigator	Paul Jubinski x6650	Satellite navigational system.
49.	HP 2115	Institute of Geophysics	"	"	" "
50.	HP 3000	Hawaii Cancer Research Ctr	General purpose time sharing	M. P. Mi 548-8490	This system is located at Queen's Hospital with 16 ports available. The system is used exclusively for research purposes and includes need for security of patient data contributed by participating doctors.
51.	HP 9835A	Sea Grant Project	Data acquisition	Ed Noda x8788	System being acquired (1/79 will be used as a data logger and analysis system for Hawaii Geothermal Project to determine effects of terrain roughness on Tsunamis.
52.	IBM 1130	Institute of Astronomy	Research remote job entry system	James Harwood x8637	In addition to serving as the remote job entry station to the UHCC IBM 370/158, some stand alone uses for data reduction is also performed
53.	TI 980B	Institute of Astronomy	General purpose time sharing	James Harwood x8637	This 4 port system is used for astronomical image processing. The laboratory is expected to be transferred to the Institute of Geophysics in July, 1979.

54.	Wang 2200S	Civil Engineering	Instructional	T. Mitsuda x7298	Used in classes on civil engineering topics for graduate students.
55.	Wang 2200S	Pacific Urban Planning Studies	Data acquisition	William Liggett x7373	Data entry from a digitizer of map coordinates. Planned for transfer to Department of Planning and Economic Development.
56.	DG Nova 200	Chemistry	Instrument Control & Data acquisition	James Loo x7503	Built-in system controlling data acquisition and manipulation of NMR spectrometer.

CATEGORY III - MICROPROCESSOR SYSTEMS

Manufacturer/ Model	Dept.	Primary Use	Contact	Remarks
A. UH Administration				
None				
B. UH Manoa				
1. 8080 (Home-made)	Electrical Engineering Microcomputer Development Lab.	Instruction	Ned Weldon x7198	Several systems based on the INTEL 8080 microprocessor circuit chip are designed and built by students each year as part of a design course (EE 462). Completed systems are used in developing other microsystems.
2. APPLE II	Pacific Biomedical Research Center	Research data acquisition	Robert Cole x8144	The system is used to control experiments and to log data.
3. APPLE II	College of Business	Instruction	Hugh Folk x6694	Development of small business systems and instruction in CAI in statistics accounting.
4. ADTECH 8080	Electrical Engineering Radio Science Lab	Data acquisition	Kazu Najita x7249	Used in atmospheric propagation studies.
5. ALTAIR 8080	Electrical Engineering Bioelectric Lab	Data acquisition	Frank Koide x7218	Biomedical experiments are conducted on this system.
6. CROMENCO Z1	Hawaii Inst. of Marine Biology	Data acquisition	George Losey 247-6631/ 948-8618	Built in to an instrument to decode analog recordings of social behavior of fish.

7.	CROMENCO Z1	Electrical Engineering	Instruction	David Stoutemeyer x8196	
8.	CROMENCO Z2D	"	"	" "	These systems will be acquired in February, '79 for use by students in EE 266 (machine language programming and computer design) and in EE 120 (Principles of Micro-computers).
9.	CROMENCO Z2D	"	"	" "	
10.	CROMENCO Z2D	"	"	" "	
11.	COMPUCOLOR 8001	Mechanical Engineering	Instruction	Fred Munchmeyer x7585	Used by students in ME courses on graphics design.
12.	IMSAI 8080	Information and Computer Sciences	Instruction	Wesley Peterson x7420	Used for teaching of microprocessor principles and software development to graduate students.
13.	IMSAI 8080	Physics and Astronomy	Data acquisition	Charles Hayes x7087	Research uses only. Controls physics experiments through acceptance of input voltages and analog output.
14.	INTEL 8748	Chemistry	Data acquisition	Price Russ x7840	Controls research experiments and logs data.
15.	OSI	Hawaii Cancer Research Center	Data acquisition	Lawrence Piette 548-8490	Used in data acquisition and analysis for cancer studies.
16.	OSI	Physics and Astronomy	Instruction	Charles Hayes	Used in Physics 274 (Modern Physics) to assist students in data analysis and logging analog data.

C. <u>UH Hilo</u>

17.	DEC Station 78	Hilo College	Instruction	Kah Hie Lau 961-9320	Used by students for computer assisted remedial courses in English and mathematics.

18.	IMSAI 8080	Hilo College	Instruction	Kah Hie Lau 961-9320	Used for teaching of data recording and analysis using microprocessors.
19.	SWITCH	Hilo College	Instruction	Kah Hie Lau 961-9320	Used for teaching of data recording and analysis using microprocessors.

D. Community Colleges

20.	IMSAI 8080	Leeward CC	Instruction	Robert Holz 455-0271	Used for teaching of BASIC computer principles to computer science students.
21.	OSI North Star	Maui CC	Instruction	Bruce Hughes 244-9181	Used in computer assisted instruction of various microbiology subjects.

CATEGORY IV - UNUSED SYSTEMS

1.	DEC PDP 8E	Institute of Astronomy Manoa	James Harwood x8637	
2.	DG NOVA 1200	Institute of Astronomy Manoa	James Harwood x8637	
3.	HP 2115	Electrical Engineering	Norman Abramson x7589	Formerly used by ALOHA Project.

APPENDIX E

FINAL REPORT OF THE MANOA SENATE EXECUTIVE COMMITTEE'S AD HOC COMMITTEE ON COMPUTER POLICY

Appendix E

January 17, 1979

Final Report of The Manoa Senate Executive Committee's Ad Hoc Committee on Computer Policy

Introduction

In October 1977 the Manoa Faculty Senate Executive Committee appointed a faculty committee to conduct a review of the status of computer utilization in instruction and research. The committee members were selected as a cross section of the general faculty with care to insure expertise. The committee returned to the SEC a proposed charter which was to delimit the scope of responsibilities of the Ad Hoc Committee. The SEC reviewed that proposal and with minor alterations approved its contents. The SEC published the committee's charter in the November 8, 1977, Manoa Bulletin. The charter reads:

"The committee will report on policy matters that relate to the relationships between computer technology and the instruction and research needs of UHM. Upon acceptance of the report by the Manoa Faculty Senate, the committee will be dissolved. The scope of the report is to contain but is not limited to the following: (1) Hardware and software acquisition, (2) Procedures for developing policy within and external to the Computing Center, (3) A review of all current policy, (4) The lines of authority and the proper role of a permanent faculty advisory committee, (5) The allocation of computer resources among users, (6) Review of plans for acquisition of a new timesharing computer, and (7) A review of the Center budget."

After receiving the charter, the committee met to formulate procedural guidelines for committee business. Individual committee members agreed to take responsibility for specific subareas of the final report and to conduct the necessary data gathering. Each member was to then formulate a working paper that summarized the input and made recommendations. Each working paper was to be circulated to those members of the faculty who had expressed an interest in reviewing our findings.

During the course of our inquiry a moratorium on the acquisition plan for a new timesharing computer was introduced and a new committee at the University System level was appointed. Our Committee decided that it was partially superceded by the

Academic Computer Advisory Committee (ACAC) and that in place of the original working papers a final document should be produced. This document is that report.

To date we have completed our investigation on the use of the computer for research and general instruction. We have also compiled information concerning computer-based education (CBE), but we are referring back to the SEC the questions related to the allocation of resouces to CBE. We believe that computer technology could be used in the future in the instructional process but we have decided not to address the broad questions of resource commitment which should be decided by the Manoa Chancellor's Budget Advisory Committee.

To collect data about the use of computing for instruction and research, we identified the largest recent users and personally interviewed them. The next 25 largest users were surveyed. For administrative staff input, we conducted direct interviews. In addition, we requested any other member of the community not covered by these means to write directly to us or to request an interview.

The Environment of Computing at Manoa

The current computer facility traces its growth from an IBM 650 to the present IBM 370. Resources have been largely centrally allocated and decisions about computing made to conform to the IBM growth path. In 1973, the Center, at the urging of members of the Information and Computer Science Department, purchased a small Hewlett-Packard timesharing computer.

Mr. Walter Yee is the director of the University System Computing Center. He reports directly to Mr. Kenji Sumida who is Director of Finance. Also reporting to Mr. Sumida is Mr. Raleigh Awaya who directs the System-wide Management Systems Office (MSO) which is responsible for the data processing effort of the University and is the Center's largest single user.

The most important piece of information we gained from the study of the formal organization has been that the Academic Vice President's office -- which at one time controlled the Center but then relinquished that control -- has no direct line to influence policy. Rather the chain is to the President, to Sumida, to Yee.

In our interview with Mr. Yee in December 1977, this committee found: (1) the Center intends to continue its commitment to the IBM growth path at least until 1981; (2) the Center feels that TSO offers very good and extensive capabilities for the professional user but is inadequate for serving a large number of users especially the casual and inexperienced user; (3) that it is likely that future administrative needs may dictate the eventual dedication of the IBM computer to the adminstrative function; (4) the University purchased the IBM 370 instead of leasing it to take advantage of certain cost reductions and that these sums would be used to get other needed equipment; (5) the Center was making plans for the acquisition of a new timesharing computer to be installed by April 1978 if possible.

This committee requested budget information, usage information, copies of policies and regulations, and copies of written documents that act to guide the Center in its planning processes. The Center was apparently unable to supply all of the information; we received only usage information and a verbal report on plans. This committee cannot therefore report on budget or policy.

This committee was charged with the responsibility of reviewing the process by which allocations of computer resources are made. The allocation of computer resources is done by the University Budget Office and each campus' head on the basis of internal usage data computed by the Center. The Center does not do the actual resource allocation. To avoid having users "burn up" resources at the close of a projection period the Center periodically shifts the closing date to get a truer reading of requirements. The explanation by users for their behavior under this system is simple: since they don't know what the procedure is by which allocations are made, they do not want their allocations to go unused as they might receive smaller allocations in the next year. We were told by fiscal officers who had large allocations that they have no idea of the process by which allocations are made though the Center administration indicated that such policies are contained in the annual UH Business Affairs Circular. In times of plentiful resources allocation is not important, but when the resources become scarce, allocation becomes critical. Most people tend to get what they request -- less some adjustment by the Center -- but a number of people have expressed dissatisfaction that the process remains closed and undocumented.

Using Computing Center data taken from their accounting tapes for the past four years this committee reduced the data into the graphs which appear at the end of this report. The measurement of computer resources used is difficult but we have selected two measures: (1) the machine unit seconds (MUS) calculated by the Center which reflect memory, computation, and input/output use on the 370; and (2) the connect hours for timesharing services on the 370 and HP. It was determined that 99% of the available resources are used by the University and not by other state agencies nor outside concerns. Figures 1 and 2 reflect the usage of MUS and connect hours by function. These function classifications are somewhat arbitrary but we feel that they provide reasonable representations of the computing mix at the University. Figures 3 and 4 illustrate usage of computing resources for instructional purposes. Figures 5 and 6 illustrate the same analyses for research computing.

Computing is not limited to the Keller Hall facility -- there are other independent computer centers throughout the System. For example, Electrical Engineering, HIG, Chemistry, Astronomy, Management Systems Office, Leeward and Kapiolani Community Colleges have significant onsite computer capabilities.

Computing and the University System Administration

To understand the communication lines and the administrative perspective we interviewed Vice Chancellor Ashton, Director Sumida, and Director Gulko. Dr. Ashton related the following: (1) the Computing Center should be a technical facility widely available for use by faculty and students, (2) decision processes to date have been in the hands of a few individuals, (3) every department should have access to computer resources for departmental administration, instruction, and research, (4) Manoa has no direct, formal line of communication to the Computing Center, (5) the University does not spend a large enough percent of its total budget on computing when compared to national averages, and (6) the acquisition of a timesharing computer should not continue until it is determined that such an acquisiton would not automatically block the possibility for a computer-based education computer.

Dr. Ashton has been identified as actively interested in computer-based education and he made the following general observations: (1) the polarization of faculty over "PLATO" or "not PLATO" is not healthy as neither extreme is reasonable and middle ground is required, (2) computer-based education will not necessarily reduce the direct costs of instruction but it might provide alternatives in delivery where none now exist and it might provide the opportunity for students to broaden themselves, (3) the stranglehold of a single vendor on specific software for instruction is unfortunate and this University should seek out consortium agreements to develop instructional material and reduce overall costs, and (4) at present it would be difficult to justify the purchase of a separate computer for computer-based education but neither should any decision be made to preclude such a possibility for the future.

In our meeting with Mr. Sumida we learned: (1) the Computing Center is a System resource and is financed by the System for all campuses, (2) there is no formal, written plan for the Center although Mr. Sumida believes that Mr. Yee is following the directions set by an advisory committee of some years ago; (3) regarding equipment acquisition, the center is believed to be responsive to user input and survey results; (4) at the time of our interview the timesharing proposal was not yet formalized and careful review was being given to Ashton's concerns about precluding the possibility of PLATO, (5) funding for the Center comes largely from general funds; the money which comes to the Center from research is maintained in a trust fund and is not reverted to the general fund, (6) most administrative computing is delayed until night time to allow academic users more capability in the day, (7) he feels that the University is generally satisfied with its current facilities and that users will always push to have improvements made; and (8) the former advisory committee was disbanded as it tended to interfere with the operation of the Computing Center. Mr. Sumida also indicated he felt it was time for a new plan for computing.

To obtain the academic view at the systems level, the committee interviewed Dr. Warren Gulko, Director of Long Range Planning in the office of Vice President Long. We learned: (1) that he felt our facilities were inadequate for both instruction and research based upon his experiences elsewhere, (2) that he felt an urgent need for the construction of long range plans for directing the growth of computing at the University, and (3) that the academic division of the University now has an interest and a concern for the academic uses of computing.

The Computer and Research

This committee personally interviewed the largest users of computing for research purposes. In addition, we surveyed the next 25 largest users to obtain their written input, and invited all other interested parties to write to us. At least half of the identified population was basically satisfied with the current environment while the balance expressed a broad range of problems of more than a transient nature. Most researchers manage to satisfy their goals, but current computing facilities often seem to introduce problems which make the work more cumbersome than it should be.

Research is a diverse activity, therefore no single direction will ever satisfy all completely. Rather, we believe that the essential requirement for computing to support research is that it focus the task of the researcher on his work and not on the processes, pitfalls, and limitations of a particular computer. The machine must amplify the researchers already skilled mind, not burden it or limit it with the imposition of unproductive detail.

Responses to our survey appear to relate to the mode of operation the researcher employs: batch users view TSO as having too many resources and vice versa. Most of the large budget users also tend to use the special purpose equipment of the Center and to use computers external to the Center. These users have found that working through the UHCC budget process makes equipment procurement more difficult than the process of securing equipment grants. Some users have recognized that their needs are too specific to warrant support by the Computing Center; hence, they have purchased their own equipment. Others have indicated that such purchases grew out of frustration with the Center.

Research users stress that the planned-for enhancement of timesharing has been delayed too long. They claim that IBM TSO is too frustrating during heavy use hours. On-line storage for large databases is noted as being too limited. Few, if any, large users use APL. Some suggest that the current operating system is too burdensome and suggest a change to alternate software. Inadequate security arrangements in using confidential data exist. Problems also occur for users who wish to connect varying kinds of terminals to the computer. Many researchers express a desire for a larger-word-size computer to avoid the complexities inherent in IBM double precision calculations.

Large-budget users view the consultants as polite, willing to help where possible, and highly motivated. UHCC consultants are viewed as best on problems with FORTRAN. The Center is viewed as having more varied software and canned program packages than did most universities with which our respondents had previously worked.

The survey asked about UHCC priorities in the event that more money were to be made available. The responses listed in priority order were: more disk storage, more computing capacity, and graphics hardware. Following these we found a need for Sunday operational hours, improved systems software, more specialist consultants, and an improved user work area.

The following represent unranked comments as we received them:

(1) Tape security is too lax; tapes are frequently lost or mislaid. Tape handlers are often too inexperienced.

(2) Consulting hours are too short and there are weaknesses in consultants knowledge of system-related and JCL-related problems.

(3) JCL and TSO command language are simply too complex to reasonably work with.

(4) Written suggestions and complaints go unanswered, or there is no answer for several months.

(5) More extensive hours of operations are needed during crunch periods. These hours should include the Monday and Thursday night system maintenance time which is viewed as too long a period for maintenance.

(6) Differential charges based on time of day could improve the scheduling behavior of users and the resource utilization of the computer.

(7) Differentiation should be made between class B jobs with intervention and those without.

(8) The access to terminals at the Center is too limited causing needless waiting and competition for the resources.

Computing and Instruction

Instructional computing is generally thought to consist of: (1) the teaching of computer programming, (2) student use of computer resources to solve class-related problems, (3) faculty use for development and support of instruction, and (4) direct delivery of instruction. Manoa makes use of each type. Each will be discussed following a summary of the general observations that apply to all types.

Although a significant minority of instructional users feel that their needs are being adequately met, most large users feel strongly that current services are unsatisfactory. The six points most frequently mentioned were:

(1) the need for vastly improved timesharing capabilities, particularly with respect to ease of use, response time, number of ports, and available disk space;

(2) the need for more terminals, keypunches, and distributed user sites which should include various input or output devices;

(3) the need for improvement to the user areas in Keller Hall, so as to provide a more adequate environment for users;

(4) the need for more consulting services for users;

(5) the need for expanded hours of machine availability, particularly on Sundays and holidays;

(6) the need for a coordinated approach to computing throughout the University and a means for user input to decision-making.

In the specific area of computer science education, there is currently very heavy use of the UHCC as well as some use of other departmental computers. There is minor use of computers on the mainland accessed over a communications network. Students taking programming courses currently spend an average of about two hours per week logged onto terminals. This figure is limited by the lack of resources and hence is not a valid basis for projection. It was suggested that in order to teach these courses properly, there would have to be an improved timesharing computer with a full range of languages, and a significant increase in the number of available terminals and ports. The ability to assign individual accounts and passwords to each student was also considered essential. In addition, it was felt that at least limited access to the IBM 370 would continue to be important.

In the area of computer problem-solving and applications, the largest current activity involves the use of software packages, particularly statistical analysis programs that are capable of generalized data analysis. The principal concerns that were expressed were for the availability of more software packages and for consultants that were trained in social science research methodology as well as computer technology.

Faculty use of computing in support of instruction currently involves the preparation of course materials, gradebook maintenance, test generation, test scoring, item analysis, and preparation of student progress reports. The principal desires expressed in this area were for the availability of better software programs and packages.

Although there are a number of independent efforts, computer-assisted instruction activities have been largely sponsored and controlled for the past two years by the Computer-Based Education (CBE) Committee. We requested information from that committee pertaining to its formation, responsibilities, objectives, plans, decision-making procedures, funding of the Pilot Project, and reporting procedures. We report below what we have been able to determine from their response.

The CBE Committee was originally formed by Walter Yee at the request of the Vice President of Business Affairs. It is chaired by Ms. Sandi McGinnes and currently reports directly to President Matsuda. The original purpose of the CBE Committee as stated by the chair, was "to make a recommendation to President Matsuda regarding what faculty require in terms of a computer and support to bring viable CBE to the campuses." Further, it was indicated that "the CBE Pilot Project has been the data gathering and information presentation vehicle for the CBE Committee's technical reports." The Pilot Project has been funded by monies from the President's Educational Improvement Fund.

In July, 1978, President Matsuda directed ACAC to take responsibility for CBE policy. Both the CBE Committee and the ACAC expect to be submitting final reports in December, 1978. At this time, it appears that the CBE committee will submit its report to Mr. Sumida with a copy to ACAC. This report is expected to contain the cummulative experiences and findings of the CBE committee over the last two years. It appears further that ACAC will be responsible for integrating this report into the overall policy direction for CBE.

Most people that were contacted felt that computer-assisted instruction would and should experience progressive growth in utilization. It was generally felt that no single computer was the best for all applications, but that there is a distinct need for coordinated direction, evaluation, and commitment in terms of computer hardware, staff support, and institutional support.

Finally, in addition to gathering information from users on the Manoa campus, we contacted instructional users at Leeward and Kapiolani Community Colleges. Their use of Computing Center facilities has primarily been on the IBM 370. Both campuses have their own smaller computers. Both cited difficulties with remote communication, but both campuses seemed interested in maintaining at least some access to large, central capabilities. Concern was expressed about System-supported user facilities and staff being located at Manoa, rather than being equally distributed among the UH campuses.

Conclusions

This report summarizes many hours of individual interviews, committee meetings, surveys, and contact with the faculty. In the conclusions that follow we are more than well aware that we may not have sufficient real data to have reached the conclusions drawn but we nevertheless present our best judgments. Furthermore, before this report is transmitted to the SEC, it will be given the test of community scrutiny and will be revised if our conclusions are not representative.

1. MANY OF THE PROBLEMS FOR COMPUTING USERS ARE FUNCTIONALLY RELATED TO THE FORMAL ORGANIZATIONAL STRUCTURE OF COMPUTING SERVICES. Our review of the evolution of the current structure for computing has shown us that it grew during the formation of the UH System. Prior to that time, the Center was a Manoa facility under the control of the Vice President for Academic Affairs. A change was made so that the Center's director reported to the Vice President of Business Affairs; the director became the director of computing for the System; and the Manoa Center became the UH System Computing Center. Even with these changes there has been relatively low use of the Center by other campuses. These organizational changes thus had the effect of removing the control of UH computing an additional administrative step or two from most of its users.

Alteration of the current structure would not be a simple task as there exist several potential conflicts. We have identified the following: (1) conflict in control of allocation of money between the System and campuses; (2) conflict in extent of policy control between the System and campuses; (3) conflicts in the needs of major user groups; and, (4) conflict between advocate groups over centralized versus decentralized computing. Reorganization would probably not be able to alleviate all the conflicts but should provide steps in the right direction. The four objectives which we feel might best improve the organization of computing services in the University appear below.

The control of computing services should be as reponsive to users as possible. Where needs are unique in the University, facilities should be unique, and control and funding should be placed at the level of the group being served. Where needs are common among users throughout the University, computing resources could be centralized. There should be coordination where feasible without sacrificing service so as to avoid unnecessary duplication and to allow sharing of resources where appropriate.

There is a need for a highly skilled, responsive technical services unit capable of providing an interface between the computer and its users. Though we recognize that many such services now exist in the Technical Services Division of UHCC, there are some functions not now performed which should be recognized: for example, more sophistication in research capabilities in both social and physical sciences. A strong alignment with academics and research is required to make the unit work and the personnel involved must have the credentials and expertise to insure the respect of the faculty.

We recognize the need for System-wide coordination of computing, and we conclude it might be best met by some type of director of computing development. This individual could serve to coordinate computing between installations where it is necessary and desirable and could act as an advisor to all administrative personnel in the System. The same individual might also assume the responsibility for long range planning. The position would require academic credentials that validate expertise. This position would not directly manage the computing function as that function rests with each campus or site. Rather, the person would act through the System to initiate, through policy, those guidelines necessary for optimal computing for the University.

Of key concern to this committee is insurance that sufficient checks and balances are placed over policy and direction of computing. This need is so vital that we single it out in a conclusion below.

2. THE CURRENT PRACTICE OF ALLOWING THE CENTER COMPLETE CONTROL OVER POLICY AND PROCEDURE IS UNDESIRABLE. During the course of our interviews with key administrative personnel we were repeatedly told of the former existence of a Technical Planning and Advisory Committee whose function it was to advise the Center on policy. We were told that the committee was disbanded because it began to interfere with the operation of the Center; on the other hand, we were told by members of that committee that this was not the case. The record is unclear on this issue but it is clear on one point: planning is currently done by a few select individuals, not subject to formal peer review, and implemented without coordinated, long range direction. Many of the decisions have been made with the best of intent and have, in fact, been reasonable. Nevertheless, the process is not sufficiently open. We believe that there should be a formal representative body to govern policy and procedure decisions and to review expenditure and equipment acquisition plans.

3. THE TIMESHARING FACILITIES OF THIS UNIVERSITY ARE GROSSLY INADEQUATE. There are two measures of computing adequacy: compute power and the kind of computing made available. Compute power relates to size of memory, speed of central processing unit, quantities of disk or other storage, machine word size and

other attributes. These are largely hardware features which can be selected for a prescribed computing need. The second measure, kind of computing, refers to the collection of software functions that are made available to a user of the computer. These include command languages, programming languages, utility programs, packaged software, communication facilities, and other functions. Every computer has these two capabilities in varying degrees but the quality of these capabilities is often overlooked. For example, IBM's TSO has all the functions but the quality is poor. The user is made to learn too much detail, to wait too long for response, to understand too many cryptic error messages, and generally to be an expert before being a beginner.

Our next timesharing computer must be selected for the kind of computing it will deliver. There are major differences among professional users, physical science researchers, other researchers, students, and small administrative users. If we must serve all these categories then care must be given to insure that each gets his own brand of computing and that we do not purchase capabilities to serve everyone uniformly but no one well. The option to have different kinds of computers for different applications should not be overlooked. If a single computer can not satisfy all current large users then the possibility of providing separate computing capabilities to various units at Manoa and to other campuses must be considered.

Due to the importance of decisions concerning the needed timesharing enhancement, maximum user input should be insured. This committee is aware of the importance of the ACAC plan to the much need timesharing computer. For that reason, we strongly encourage the SEC and other interested parties to review closely the findings ACAC and to submit comments directly to that committee.

4. THE EFFORT TO INTRODUCE COMPUTER-BASED EDUCATION HAS BEEN INAPPROPRIATELY FORCED TO COMPETE WITH OTHER COMPUTING NEEDS. It is likely that computer technology could continue to be increasingly used in the process of instruction. When hardware costs drop and when more universal software for instruction is available then it is likely that computer-assisted instruction could see increasing utilization to supplement and enhance the ongoing process of instruction.

Small projects have been put in motion through grants from the President's EIF, but as faculty members seek to continue and expand their projects they are stymied by the general lack of resources. They should not be made to compete with other users of computing. Nor, should the users of general computing whose needs were well established before the advent of current CBE efforts be made to further yield resources that are already in short supply.

The faculty is concerned about the relationship between CBE expenditures and their impact upon other areas which have gone without support. We do not believe that the computer will radically alter the employment patterns nor the basic functions of the University in the near future. We do believe that the computer will continue to grow in importance as a tool. We believe that unless careful planning about the parameters of expansion of the computing use in the instructional task are laid out for examination, prejudice may cause further deterioration in morale and increased friction among faculty.

5. THERE IS A LACK OF WRITTEN POLICIES AND PROCEDURES REGARDING COMPUTING. In the past, the source of policy was the Center's user's guide which today has been replaced by references including documents, several years of newsletters, online catalogues, and word of mouth. Neither organization is acceptable and a more organized policy manual is needed. The type of policy statements needed are those concerning resource allocation, legal use of facilities with reference to faculty research and consulting, priorities for access to the computer during extreme use periods, and others.

6. THE CURRENT PHYSICAL FACILITIES AT THE KELLER HALL SITE ARE INADEQUATE. There is an obvious lack of sufficient space to sit and to work in the main Center. The 'user area' is nothing more than a hallway in which users are forced take uncomfortable positions to secure even a small amount of space. The terminal rooms on the second floor are overcrowded and the conditions are nearly unbearable. The air conditioning is inadequate. The noise level is too high and competition for resources is too extreme. Resources such as reference manuals are in far too short supply. Students, researchers, and other users should not be made to suffer with these facilities any longer.

The changes required at Keller include the immediate reassignment of classroom space to a user work area. After that, keypunches, more terminals, a consultant, a card reader, and a printer should be placed on the second floor. Ideally, a library should also be established on the second with reference manuals and other literature on computing. The development of other user sites on campus might also serve to improve the current problem.

SUMMARY

It is simple to conclude from much of the tone of this report that the environment of computing at the UH is poor. This is not the case. Many significant improvements have been made in computing here due to the contributions of concerned faculty, Computing Center administration, and Center staff. In this report we have sought to show areas that need review so that the University may assure itself that the vital function of computing will be provided in the best possible way.

We have labored to be fair to all parties in writing this report but we feel that we are compelled to single out the urgent need for vastly improved timesharing capabilities. To ignore the urgency of this need in the academic community is tantamount to the introduction of significant negative factors for research and instruction. We believe that this University's research capabilities will be greatly hindered and the securing of extramural funds impaired. Futhermore, there is a likelihood that faculty who use computers in their work may well decide to leave this University or decide to discontinue their vital research. Moreover, students will continue to be denied adequate facilities which will result in limiting their abilitiy to compete with similarly educated students from the mainland. We are providing students who seek to use and understand computing a second-rate facilities. In general, we feel that the damage that would be done to instruction and research by ignoring the need for improved timesharing will be significant and long lasting.

Kent W Bridges

Kent Bridges

Peter Dunn-Rankin

Peter Dunn-Rankin

Carl Farrell

Carl Farrell

Patrick Gilbert

Patrick Gilbert, Chair

W. Wayne Lichtenberger

Wayne Lichtenberger

Forrest Pitts

Forrest Pitts

btal University MUS's

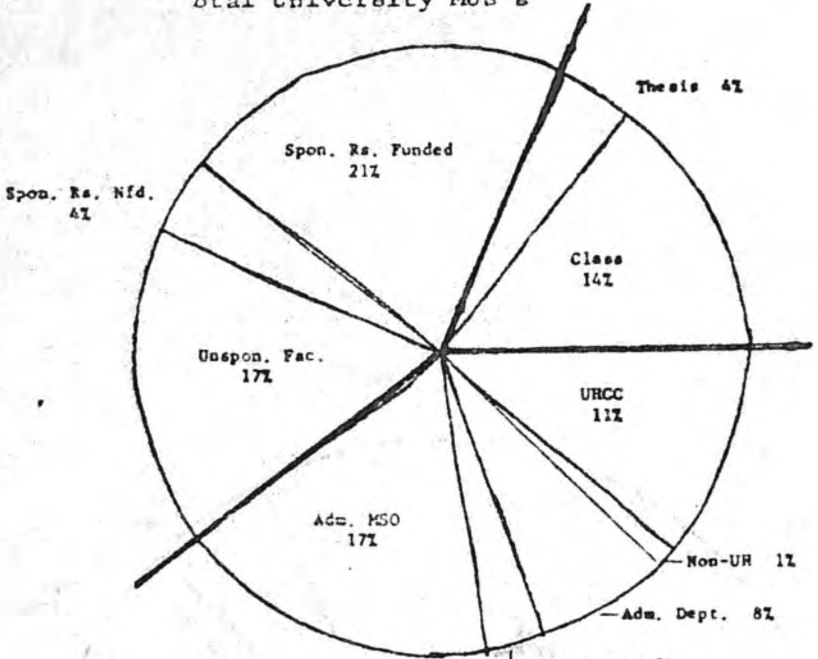


Figure 1

Total University T/S Connect Hour

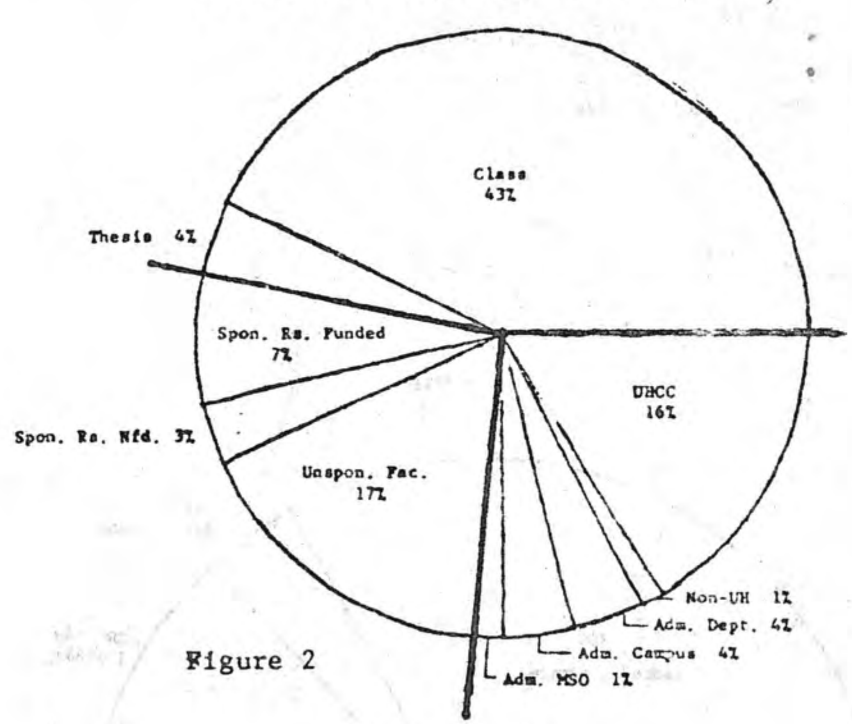
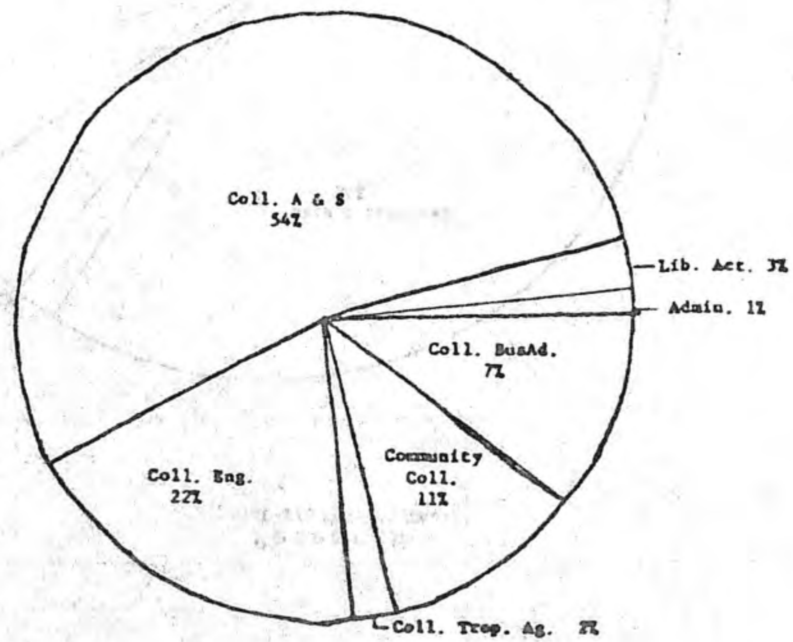
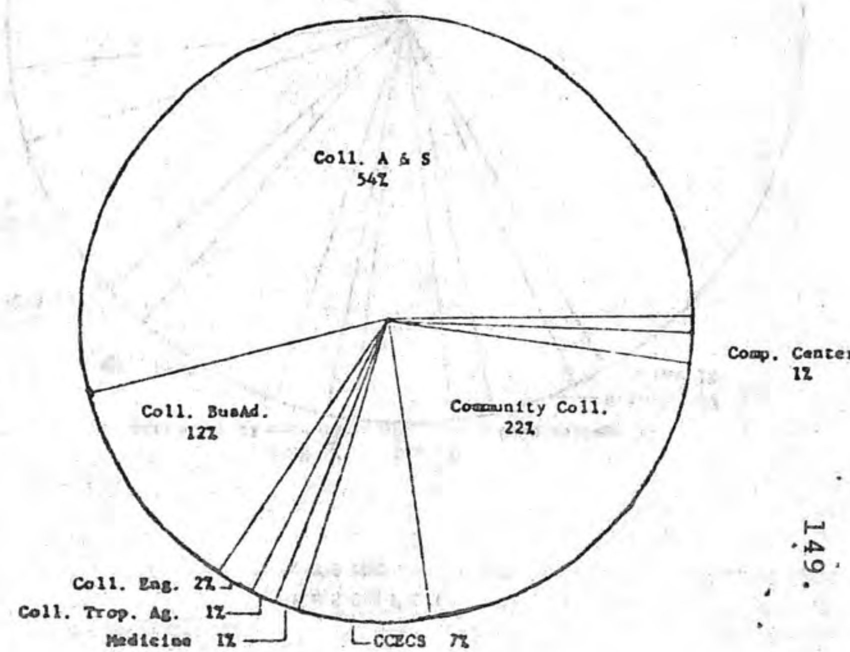


Figure 2

Instruction MUS's Only (S/370)



Instructional TS Connect Hours Only



Research
TOTAL T/S Connect Hours

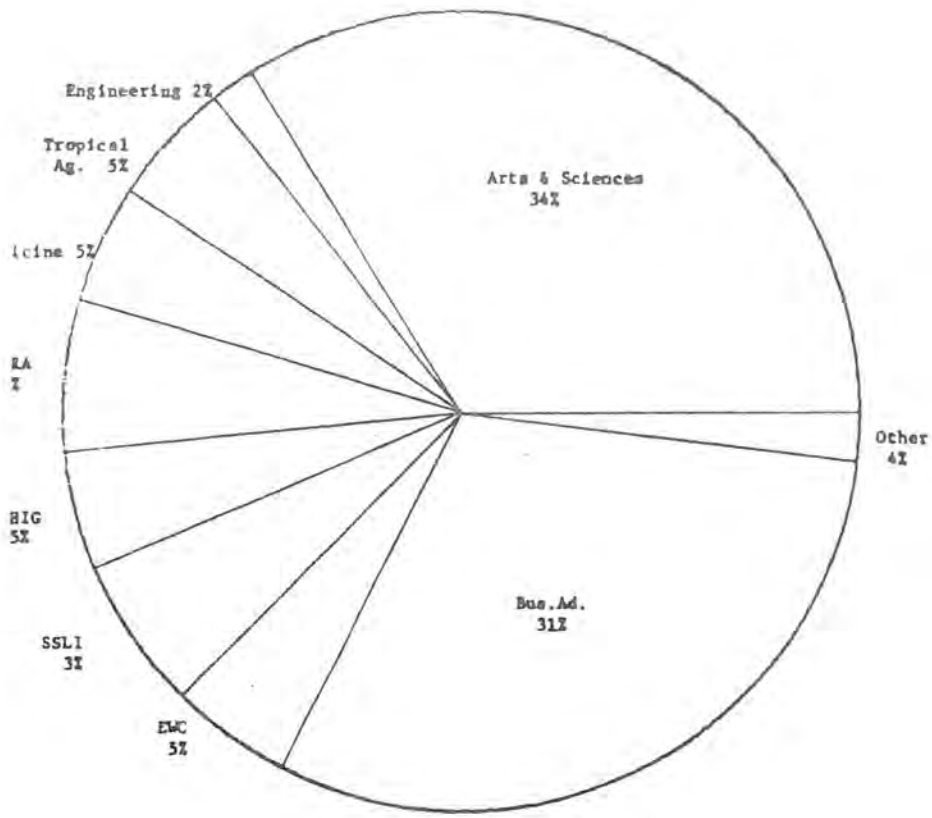


Figure 5

Research
370 MDS

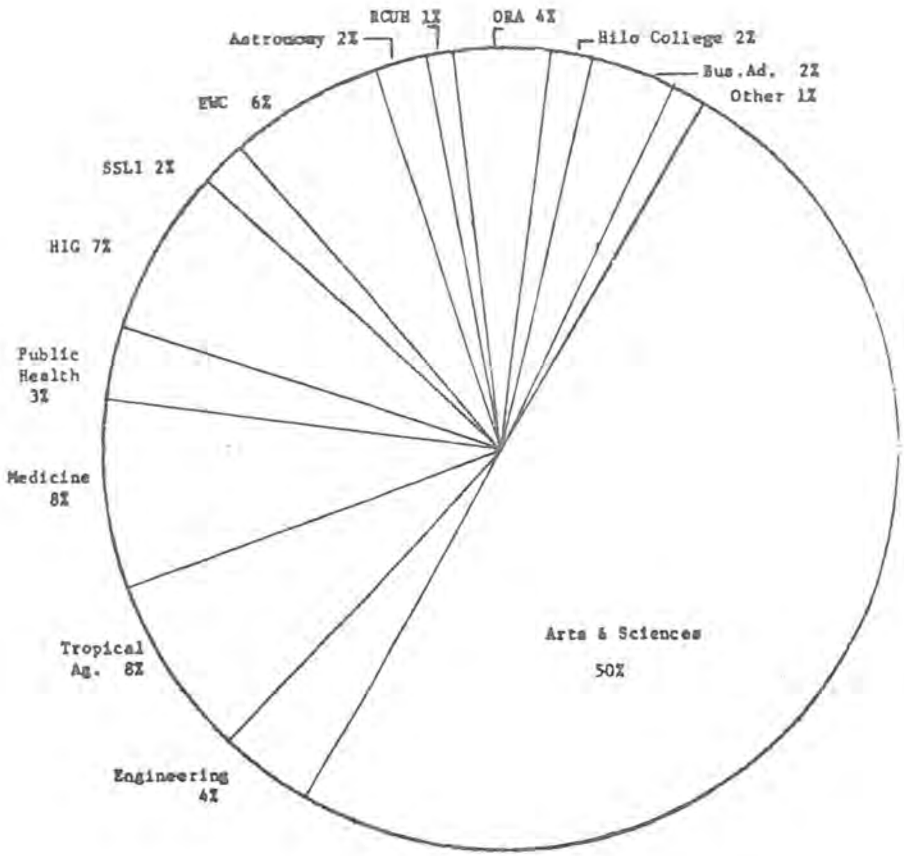


Figure 6

APPENDIX F

GLOSSARY

Appendix F

GLOSSARY

APL	A Programming Language. A problem solving language designed for use at remote terminals; it offers special capabilities for handling arrays and for performing mathematical and logic functions.
Batch Processing	Pertaining to the technique of executing a set of computer programs such that each is completed before the next program of a set is started. Also, a job which is grouped with other jobs as input into a computer system. Batched jobs are usually processed in low priority on computer system which execute both batch processing and teleprocessing tasks.
CAI	Computer Assisted Instruction. A data processing application in which a computing system is used to assist in the instruction of students. The application usually involves a dialog between the student and a computer program which informs him of his progress and mistakes as he makes them.
COBOL	COmmon Business Oriented Language, a business data processing language.

Computer Program — A series of instructions or statements, in a form acceptable to a computer, prepared in order to achieve a certain result or results.

Debugging — To detect, locate and remove mistakes from a computer program or malfunctions from a computer. Synonymous with trouble shooting.

FORTRAN — FORmula TRANslating system. A programming language primarily used to express computer programs by arithemetic formula. FORTRAN is the most widely used computer language.

GPSS — General Purpose Systems Simulator, a program package used for linear modeling and simulation of processes and systems.

Hardware — Physical equipment, as opposed to the computer program or method of use, for example, mechanical, magnetic, electrical, or electronic devices. Contrast with software.

HP 2000 — A Hewlett-Packard timesharing system using a single computer language (BASIC) currently configurated with 32 access ports.

IBM 370/158 — A particular model of the IBM series of computers. The currently configured system employed by the University is a large scale batch computer with medium scale limited timesharing capability.

Interactive	Pertaining to an application in which each entry elicits a response, as in an inquiry system. Interactive also implies conversation or continuous dialog between a user and a computer system.
Network	In teleprocessing, a number of communication lines connecting a computer with remote terminals and/or other computers.
On-line	Pertaining to equipment or devices under control of a central processing system. In teleprocessing, a system in which the input data enters the computer directly from the point of origin or in which output data is transmitted directly to where it is used. Also pertains to a user's ability to interact with a computer. Contrasts with off-line.
PL/I	Programming Language 1, a high level programming language, designed for use in a wide range of both commercial and scientific applications. The language, in the minimum, combines the facilities of FORTRAN, COBOL and ALGOL and enables extensive character manipulation in addition to arithmetic capabilities.

Plug-compatible	Pertains to equipment which may be substituted for another to perform exactly duplicate functions without the necessity for major modifications to any equipment.
Port	In data communications, that part of a data processor or computer which is dedicated to a single data channel for the purpose of receiving data or sending data to one or more external remote devices, usually terminals.
RJE	Remote Job Entry. High speed submission and receipt of computer tasks from a remotely located facility.
SIMSCRIPT	A programming language for simulation and modeling studies.
Software	A set of computer programs, procedures and possibly associated documentation concerned with the operation of a data processing system. For example, compilers, library utility programs, program packages for statistical analysis, and manuals. Contrasts with hardware.
SPSS	Statistical Package for Social Scientists. A package of computer programs which enable performance of wide range of statistical analysis with minimal effort on the part of the user.

Teleprocessing	The processing of data that is received from or sent to remote locations by way of tele-communications lines and or equipment.
Terminal	A device usually equipped with a keyboard and some kind of display or printer, capable of sending and receiving information over a communication line.
Timesharing	Pertaining to the interleaved use of time of a device. It is a method of using a computer system that allows a number of users to execute programs concurrently and to interact with programs during execution.
Turnaround	The elapsed time between submission of a job and the return of results from a computer system.
TSO	Time Sharing Option. This is the generalized timesharing system provided on IBM systems.
Unit Record Equipment	Genrally refers to computer peripheral and ancillary equipment which are used for processing cards and printing.